TELEPHONE ENGINEER

Volume 30 SEPTEMBER, 1926 Number 9

WHO WILL WRITE A TEXT ON PLANT ENGINEERING?

This journal recently received an inquiry from a plant engineer in a growing telephone system of many thousands of stations, in which we were asked to suggest some standard engineering text which could be made the basis for study by a group of student engineers. We were compelled to answer that there is no such text in existence. There are chapters in certain books, some of which are now obsolete, and many scattered articles in telephone literature, but no complete or systematic treatment.

Along the same lines, more than a year ago, we had an inquiry for an article dealing with a certain phase of plant engineering work. We happen to be acquainted with a number of men in both Bell and Independent organizations who are qualified to write on this subject and we have approached several of them, but, as yet, we have not found one who will undertake the preparation of the article.

We are not criticizing these men; their obligations to their companies and to themselves come first, but we do say that it is an unfortunate thing for their fellow engineers and for the industry at large that there seems to be no one who has the ability, and, at the same time the leisure, to prepare a comprehensive text on plant engineering practice. TELEPHONE ENGINEER would like to hear from anyone who might be interested in this undertaking.

COMMISSIONS' PURPOSE IS TO PROTECT THE PUBLIC

In an order, disapproving an application for a bond issue to finance the consolidation of several telephone companies, the Public Service Commission of Indiana served notice that it intends to scrutinize carefully all applications for purchase and sale and for financing that come before it. The commission says that it will consider not only sound values but the ability of the purchaser to give good service.

This journal has no opinion to express concerning the merits of the particular case, but it has repeatedly called attention to some of the dangers to the industry that may arise from certain types of financial activity. It is evident that at least one state commission is alive to these dangers and does not intend to become a party to financial loss or service deterioration by perfunctory examination and hasty approval of the projects presented to it.

Most public utilities commissions are given this power in cases involving purchase and sale and security issues. If they will exercise it wisely and conscientiously, no one with a legitimate proposition will suffer. On the other hand, fly-by-night promoters will find no happy hunting ground in the states where the commission are "on the job" and are considering the interests of the public and the investor before approving the applications placed before them.

TRANS-ATLANTIC TELEPHONY FIGURES IN RADIO DEAL

There was some surprise at the recent sale of broadcasting station WEAF by the American Telephone and Telegraph Company to the Radio Corporation of America. It was not known that the A. T. & T. Co. considered withdrawing from the broadcasting field after having shown the way of making broadcasting pay by the sale of time on the air. It now seems that this sale was in the nature of a portion of the consideration for the use of facilities for trans-Atlantic radio telephony, if reports in certain syndicated newspaper articles are true.

It is intimated that the technical details were worked out several months ago to the point where trans-Atlantic traffic on a commercial scale might be handled, but not all of the commercial and traffic arrangements have been made. One of the difficult matters to be worked out is caused by the fact that there are only two hours in common between the London and the New York business days.

It will be only a question of time until London telephone calls will be a regular feature of the service, not only from New York but from any point on the American long distance lines. It is interesting to speculate upon the possible volume of traffic that will be developed, and upon the effect that constant voice-to-voice communication will have on relations between the nations.

CONNECTING COMPANIES HOPE FOR FAVOR

Both the telephone business and general business should profit by the action of the American Telephone and Telegraph Co. in filing a reduced schedule of interstate toll rates. The large increase in the volume of long distance business and the development of new methods of operation have made the long-lines business of the Bell system quite profitable, and the officials of that company are passing back to the telephone user some of the benefits in the form of reduced rates.

In the long run, it is expected that the reduction will create additional business and the user of long-lines service certainly will benefit by the substantial cut in cost of his calls. The increase in length of time to which reduced rates apply should be a popular move and only a few will be adversely affected by the elimination of the night rate after midnight.

In passing around its favors, the Bell system recently gave its associated companies a nice reduction in the license charge from four and one-half to four per cent. It now gives the public a substantial reduction in long distance rates.

May we hope that it will not overlook the connecting companies. The Bell's own figures for the cost of setting up a direct circuit toll call is in excess of what many connecting companies operating Class 2 toll centers get for building up a long haul connection to a distant point. Even then, the connecting company frequently passes back part of its commission to the tributary office. Perhaps the connecting companies will be the recipients of the A. T. & T. next favor.

KEEP PLANT AND SERVICE UP TO STANDARD

Taken as a whole, the telephone industry is in a fairly prosperous condition, and yet if the question "How is business?" is asked of the average salesman who is calling on the telephone trade, he is likely to reply: "Business is fair but not as good as it should be." Pressed for reasons for the existence of this condition, he is likely to explain that many companies seem to be holding off from buying, due to uncertainty as to their future.

If this is true, it is an unfortunate state of affairs. Ordinarily the company that is doing well should make extra efforts to improve its property during periods when it is relatively prosperous. Furthermore, commodity prices seem to be holding down to a fairly low level without much prospect of further decrease, making it a favorable time to buy. This is particularly true of many of the materials used in plant construction.

The only uncertainty that is evident in the telephone business is the uncertainty that exists in some companies as to whether they will continue to operate or will sell their properties. To let this uncertainty interfere with making necessary replacements or plant extensions is to take a very short-sighted view of the duty of the company to render service to its subscribers. As long as a company continues to operate its property, it owes a duty to its patrons to keep its property in order; to take care of new business that is offered and to maintain service of a proper standard, regardless of the future plans of the stockholders or owners.

THE CONVENTION CALENDAR

NEW HAMPSHIRE
Concord, Parish House, September 16 and 17.

MAINE
Augusta, Augusta House, September 21 and 22.

INDIANA
Indianapolis, Claypool Hotel, September 21, 22 and 23.

TELEPHONE ASSOCIATION OF CANADA
Montreal, Windsor Hotel, October 12, 13 and 14.

UNITED STATES INDEPENDENT TELEPHONE ASSN.
Chicago, Hotel Sherman, October 12-15.

ILLINOIS
Springfield, Hotel Abraham Lincoln, November 10 and 11.

SOUTH DAKOTA.
Sioux Falls, January 13, 14 and 15, 1927.

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COLLECTING FROM THE SERVICE LINES

In the August number of this journal, we took occasion to comment on the problem of making collections from mutual or service lines. That the subject is a live one is evident from the number of letters received from subscribers. Several of these appear in another part of this issue and serve to illustrate, not only the way in which the problems have been met but also the willingness of telephone men to share their experience with others, so that all may be benefited.

CHECK NOW ON YOUR SEASON'S WORK

With the construction season nearly gone, it is a good time to check up on results that have been accomplished and note progress on uncompleted work. If the work is progressing well, perhaps some additional project may be worked out before too late in the year. If it is lagging, there is yet time to put on additional effort so that the work will not drag on into bad weather, later in the season. Early planning and continual checking of progress will produce results in the construction department that can be achieved in no other way.

Elementary Theory of Electricity

By F. J. DOMMERQUE
Fellow A. I. E. E.

24. Electrification and the Electric Field

The name "Electricity" is derived from the Greek word "elektron," which means "amber." More than two thousand years ago the Greeks had observed that when a piece of amber is rubbed with wool it will attract light bodies such as pieces of straw. The term "electricity" has first been used by the English physicist Gilbert in the sixteenth century.

When certain substances are rubbed briskly with a piece of dry flannel or with silk, they will assume a peculiar state in which they attract light bodies such as bits of paper. For experimenting purposes physicists used pith balls suspended by silk treads. Such a pith ball, when free to move, will be attracted by a stick of sealing wax rubbed with a piece of dry flannel and held near to it. If the ball is allowed to touch the wax, it will immediately fly away; that is, the wax will repell it.

A glass rod rubbed with a silk handkerchief will exhibit similar properties; first it will attract the pith ball, but after contact with it it will repell it. Taking a glass rod of some length and rubbing it energetically with a piece of fur, a crackling noise will be heard, and in the dark small luminous sparks will be observed to jump over between the rod and the fur.

When substances by being rubbed assume this peculiar state, it is said they are *electrified;* it is by virtue of the electrification that the power of attraction or repulsion arises. The region in which the attractions and repulsions are observed is called the *electric field.*

If the pith ball is touched by the sealing wax, after the latter has been rubbed lightly with a piece of flannel, the ball will be repelled a certain distance. If the sealing wax is rubbed harder and then the pith ball is touched again, a greater repulsion will be noticed. The same effect is obtained from amber, shellac, sulphur or any resinous substance.

If, however, a glass rod is rubbed with a piece of silk and with it a pith ball is touched which has been electrified by sealing wax, it will be found that the ball will be attracted by the glass rod. The same effect as with glass is obtained with a diamond or vitrious substances. Thus it is seen that there exist two groups of bodies which show different effects when rubbed, the effects of the two groups being of opposite character. The state of the ball which has been in contact with the glass rod is said to be one of *positive electrification,* or the ball is said to be *positively electrified;* the state of the ball which has touched the sealing wax is said to be one of *negative electrification,* or the ball is said to be *negatively electrified,* the act of rubbing serving simply to make the contact more intimate.

The terms positive and negative in this conjunction are only conventional, as there is no essential difference between positive and negative electrification. That developed on glass is sometimes called vitrious, that on sealing wax resinous. The explanation of the action of the electrified bodies on the pith ball is given by assuming that *unlike electrifications attract, like repel.* Every body in a neutral state is said to possess equal quantities of the two kinds of electrification, the operation of rubbing simply separating them. In accordance with this hypothesis the pith ball being uncharged, when brought near the glass for example, the positive charge on the latter attracts toward itself the negative electrification of the pith ball, while it repels the positive electrification to the far side of the ball. The charges are equal, but the negative being the nearer, the positive of the glass rod attracts it; upon contact some of the positive charge of the glass is imparted to the pith ball and repulsion ensues. If the negatively electrified sealing wax is now brought near, it attracts the positively electrified pith ball and draws it toward itself. If the pith ball is originally negatively charged, it will be repelled by the wax and attracted by the glass.

An electrified body can impart electrification to another body in two ways. If it comes into contact with it, the charge is said to be given by *conduction,* and is of the same sign as that of the charging body. A charge can also be given by *induction* in the following manner: If an uncharged body is brought near a charged one, the equal and opposite electrifications of the former are separated; that unlike the charge of the inducing body being drawn toward that body, that of like sign being repelled from it. These electrifications are separated only during the presence of the inducing body; they are said to be *bound* and reunite as soon as the inducing body is withdrawn. If, however, before the withdrawal of that body, the other is touched or put in connection with the earth by a wire or otherwise, the charge of like sign is carried away, and when the inducing body is removed, the other is found to be oppositely electrified. A body charged by *conduction* has the same kind of electrification as the charging body; one charged by *induction* the opposite kind.

A *conductor* is a body which readily conducts electrification; a *non-conductor,* one which does not readily conduct it. Metals are the best examples of conductors; glass, air, silk, rubber, wax and shellac the best examples of non-conductors or *insulators,* as they are called. There is no perfect conductor, no perfect insulator; no substance is so good a conductor that it does not oppose some resistance, however minute, to the transfer of electrification; no insulator is so poor a conductor that it does not transmit some. A non-conductor has no tendency to distribute a charge given to it. A charge imparted to a conductor on the other hand spreads itself over it, if a sphere, uniformly; if an elongated body, in such a manner that the greatest density is upon the ends. The charge always resides upon the surface. If a small charged body is placed within a hollow sphere, but not in contact with it, the outside of the sphere will be electrified similarly to the charged body, the inside oppositely. If the outside of the sphere is touched, the bound charge is conducted away, and the charge of opposite sign to that of the inducing body remains. If the latter is now withdrawn, the electrification of the sphere will be found upon the outside, no charge being discernible upon the inside. If the two charged spheres are brought within one another's influence, there will be an action between them, tending either to separate them farther or to draw them together. If the spheres are small compared with the distance between their centers, the magnitude of the force of attraction or repulsion will be $F = \frac{kq_1q_2}{d^2}$, where q_1, q_2 are the charges on the spheres and d

**Fifth article on "Telephone Mathematics and Physics."*

the distance between their centers, k being a constant. If q_1 and q_2 are of like sign, either positive or negative, the force is positive, that is, a repulsion tending to increase the separating distance. If q_1 and q_2 are of unlike sign, the force is negative; that is, an attraction tending to decrease the distance.

This expression is analogous to that giving the action between two magnetic poles, and as in that case, the constant k can be made unity by suitably choosing the units of measurement and considering the action to take place in the standard medium, in the vacuum. If the spheres are equally charged, the force acting between them will be $F = \frac{q^2}{d^2}$, whence $q = d\sqrt{F}$, giving the dimensions of the electric charge as $C^{3/2}G^{1/2}S^{-1}$, the same as the dimensions of the pole strength.

Around an electrified body, as around a magnet, there exists a field of force, mapped out by lines of force. The positive direction of the lines of force is that along which a positively charged body would move. As a positive charge is repelled from a positive charge and attracted to a negative, it follows that the positive direction of lines of force is from positively electrified to negatively electrified bodies. Lines of force are then said to begin upon positively charged bodies and to end upon negatively charged bodies. If a sphere possessing a positive charge is suspended in a room, the negatively charged body to which the lines arising from the sphere extend, may not at first thought be apparent, but a little consideration will show that the walls of the room are negatively charged, the electrification being bound by the positive charge on the sphere. The lines of force accordingly extend from the sphere to the walls.

The conception of lines of force is of assistance in explaining and predicting what will happen if electrified bodies are brought in proximity. These lines are supposed to act like rubber bands tending to contract and to become parallel, and producing a pressure at right angle to their length. As lines extend from positively to negatively charged bodies, there will be a pull along them, and the bodies will, if free, move together. If both bodies are either positively or negatively charged, the lines do not extend from one to the other, but around, in a general direction, at right angles to the lines joining the bodies, tending to parallelism and exerting a repulsive force.

25. Potential

It is well known that a falling body can perform work during its fall. In falling the body changes its position from a higher to a lower elevation. A body elevated to an altitude can fall when its support is removed. The support prevents it from performing work. The faculty of a body to perform work may be called its energy, whence the faculty of a body to perform work in consequence of its elevation may be designated as potential energy or briefly as its potential. A body can perform work not only in falling—that is, in moving downward—but in moving in any direction, it has to overcome the force which prevents it from moving.

The formula for the force of attraction or repulsion $F = \frac{kq_1q_2}{d^2}$ shows that the force between any two electrified bodies is proportional to the charges, thus the magnitude of the charges can be estimated from the magnitude of the force, and a unit charge may be defined as one which, placed at a distance of one centimeter form an equal and similar charge, repels it with a force of one dyne. If a positively electrified body is moved toward a similarly electrified body, work will be done in overcoming the repulsive force, and the more closely the bodies are approached the greater the force and the more power that must be expended. If one body is allowed to move under the action of the repulsion, it will be driven away, and theoretically will move to an infinite distance, for the expression $F = \frac{q_1q_2}{d^2}$ shows that some force will exist, if d is anything short of infinity. Assuming a repelling charge q_1, and a unit charge q_2 of the same sign at an infinite distance, then there is no force of separation; but as the unit charge is brought toward the charge q_1 the force increases, and the work expended likewise increases. Let the unit charge be moved up to some point P. The work performed in moving the unit charge from an infinite distance to the point P is then the *potential* at that point. Similarly, if the unit charge were brought from an infinite distance to a point P^1, the work required to effect this movement would be the potential at that point. If the points P and P^1 are at different distances from the charge q_1, they are at different potentials, for different quantities of work are required to bring the unit charge to them from infinity. The *difference of potential* between two points may then be defined as the work performed in moving unit quantity of electrification from one to the other. If more work is done in reaching P than in reaching P^1, P is said to be at a higher potential than P^1, and work is done in moving unit charge from P^1 to P. Conversely, the unit charge does work in moving from P to P^1, that is, in moving from places of higher to places of lower potential.

Let the potential of the point P be V, and V^1 the potential of the point P^1, the difference of potential is then $V - V^1$, which is the work performed in moving unit electrification from the lower potential V^1 to the higher potential V. If the charge is not unity but Q, the work performed is $W = Q(V - V^1)$, whence the difference of potential $V - V^1 = \frac{W}{Q}$.

The dimensions of work W were found previously as C^2GS^{-2} and the dimensions of the electric charge Q as $C^{3/2}G^{1/2}S^{-1}$, whence the dimensions of potential difference are found by dividing those of W by those of Q obtaining $\frac{C^2GS^{-2}}{C^{3/2}G^{1/2}S^{-1}} = C^{1/2}G^{1/2}S^{-1}$.

26. Electromotive Force, Current and Capacity

A difference of electric potential is capable of causing a transference of electrification from the place of higher to the place of lower potential. This transference or flow takes place under a so-called *electromotive force* (abbreviated e. m. f.). There may be a flow, there may be not. If two spheres charged to different electric potentials are insulated, there is no sensible transference of electrification. If they are connected by a wire, however, a flow takes place through the conducting power of the wire, and the difference of potential is neutralized.

If various wires having different conducting powers are used to connect spheres charged to given differences of potential, the flows will in general be different, some materials allowing a more rapid equalization of potential than others. The rate of transference of electrification over a conductor is called the *current*. It is the quantity of electrification which crosses a given section in a given time. It is defined by $I = \frac{Q}{t}$, where I is the current and Q the electrification crossing any section of the conductor in the time t. The dimensions of I are therefore the dimensions of Q found above as $C^{3/2}G^{1/2}S^{-1}$ divided by S, or $C^{3/2}G^{1/2}S^{-2}$.

Two spheres maintained at a constant difference of potential, when connected by a wire, cause a current to flow over that wire, whose magnitude is dependent upon the dimensions and character of the conductor. The relation between the potential difference and current is contained in the celebrated Ohm's law, which states that "the current is proportional directly to the potential difference and inversely to the resistance." Algebraically written $I = \frac{(PD)}{R}$, where I is the current flowing under the potential difference (PD), the resistance of the conducting wire being R. This resist-

ance is the opposition offered to the passage of the current, and is directly proportional to the length of the conductor, inversely proportional to the area of the cross-section, and directly proportional to a constant depending upon the nature of the substance of which the conductor is formed. This relation can be expressed by writing the value of R as $R = \frac{l\rho}{a}$, where "l" is the length of the conductor, "a" the cross-sectional area and "ρ" (Greek letter for r) the constant mentioned above and called the resistivity. As R is equal to the difference of potential divided by the current its dimensions are found as $\frac{C^{1/2}G^{1/2}S^{-1}}{C^{1}/^{2}G^{1}/^{2}S^{-2}} = C^{-1}S$, which is the reciprocal of velocity.

If the charge is imparted to a conductor, its potential will rise. This will at once be apparent when considering that potential is work, the potential at, or of, a conductor being the work that must be performed in bringing up to it from infinity a unit charge of the same sign as that of the conductor. If the conductor is uncharged, the work is nothing, and the potential zero. If the conductor is now charged from zero, its potential will increase, and by an amount, which is proportional to the quantity of electrification given it. The *capacity* of a conductor is defined as the quantity of electrification which will raise its potential to unity when all surrounding bodies are kept at zero potential. Thus defined, the capacity C is given by the equation $C = \frac{Q}{V}$, that is, it is the ratio of the charge of a conductor to its potential, the charge which a conductor will acquire being directly proportional to its capacity. Two conductors placed near each other, but insulated from each other form what is called a *condenser*. If the conductors are flat plates and are brought very close together, they may acquire a considerable charge with a comparatively low potential. If the electrifications of the plates are equal and opposite, the capacity of the condenser is the charge on either plate when the potential difference is unity.

27. Circular and Trigonometric Functions

Before we can continue our explanation of the fundamental principles of electricity it will be necessary to inject some more mathematics. This time it will be the trigonometric functions. The reader already knows what functions are; a function is a quantity which depends upon another quantity for its value; trigonometric functions depend upon the sides of a triangle for their value. The designation "trigonometric" is derived from the Greek words "trigonon" and "metrein"; trigonon means "triangle" and metrein "to measure." The purpose of trigonometry is not so much to measure the triangle itself as to measure its angles and side relations.

Previously, when we illustrated the use of graphs, we designated the angles with reference to the circle, which we divided

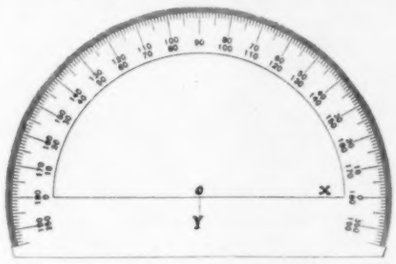


Fig. 15.

into degrees, minutes and seconds. One way to measure an angle is to take as measure the arc subtended by the angle.

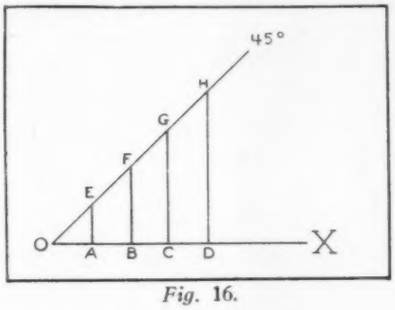


Fig. 16.

In Fig 5 (page 26, May, 1926, TELEPHONE ENGINEER) the arc of the circle between 0° and 45° measures the angle between the line OX and the line drawn from 0 through the point on the circumference marked 45°. Another way to

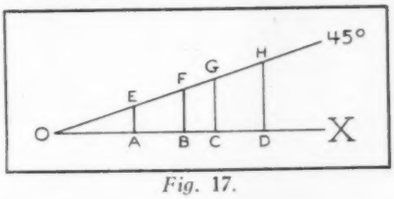


Fig. 17.

measure an angle is with reference to the sides of a triangle.

The first method takes as unit of

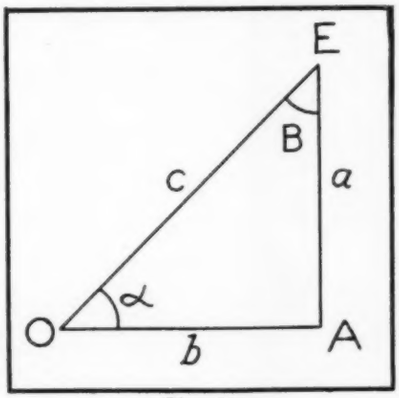


Fig. 18.

measurement the angle subtended by an arc which in length is equal to the radius of the circle and is known as *circular* measure; correspondingly we speak of circular functions. The angle subtended by an arc equal in length to the radius of the circle or also the arc itself is termed a "radian." The circumference of a circle is $2\pi r$, whence 2π radians $= 360°$ and 1 radian $= \frac{360°}{2\pi}$ or $\frac{360°}{6.2832}$ which is approximately 57.3° or 57°17'45".

Thus the relation between circular measurement and measurement by degrees is the following: Circular measure = degrees times $\frac{\pi}{180} = 57.3$ times degrees. Degrees = circular measure times $\frac{180°}{\pi} = 0.0174$ times circular measure. To measure angles in degrees a *protractor* may be used, such as illustrated in Fig. 15. The origin of the system of coördinates from which the angle is measured is marked by 0 and the coördinate axes by X and Y respectively. The protractor as used by surveyors and engineers is usually made of metal so as to be durable. To measure an angle with a protractor, place the protractor with its center marked 0 over the angle so that the *vertex* of the angle (the point where the two sides of an angle meet is called the vertex of the angle) and the point 0 coincide, and that the one side of the angle coincides with the X-axis; the other side of the angle will then cut the graduated arc of the protractor; the number marked nearest the intersection gives the degrees of the angle, the minutes must be estimated.

In Fig. 16a the 45° angle of Fig. 5 is redrawn, but the points 1, 2, 3, 4 on the X-axis are lettered A, B, C and D instead of numbered, while the points on the 45° side of the angle are lettered E, F, G and H. As the lines AE, BF, CG, DH are ordinates, the triangles OAE, OBF, OCE and ODH are right triangles, the angles OAE, OBF, OCE and ODH being the right angles, while all other angles are 45° angles which can be proved by measuring with the protractor. Furthermore, all the triangles are *similar*, that is, the three corresponding angles of each triangle are of the same magnitude. All the triangles have the same 45° angle at the vertex 0 in common, and the corresponding sides of the four triangles are proportional, that is:

$$\frac{EA}{OE} = \frac{FB}{OF} = \frac{GC}{OE} = \frac{HD}{OH}$$

$$\frac{EA}{OA} = \frac{FB}{OB} = \frac{GC}{OC} = \frac{HD}{OD}$$

$$\frac{OE}{OA} = \frac{OF}{OB} = \frac{OG}{OC} = \frac{OH}{OD}$$

Each of the above ratios is a function of the angle at 0. It is, however, not necessary that the angle at 0 is a 45° angle, the ratios hold good for any angle such as shown in Fig. 17, as long as the triangles are right triangles.

We now draw the triangle OAE separately and enlarged in Fig. 18. For sake of simplicity we mark the sides of the triangle a, b and c and the angle at 0 by α (Greek letter for a), the small arc inscribed in the angle EOA serving as an identification mark that this is the angle under consideration. It may be mentioned here that it is customary to designate angles either by a Greek letter written inside the angle or by the three letters of a triangle, placing the letter at the vertex of the angle in the middle.

The ratios $\frac{a}{c}, \frac{b}{c}, \frac{a}{b}, \frac{b}{a}, \frac{c}{b}$ and $\frac{c}{a}$ are named as follows:

$\frac{a}{c}$ is called the *sine* of α, written $\sin \alpha$;

$\frac{b}{c}$ is called the *cosine* of α, written $\cos \alpha$;

$\frac{a}{b}$ is called the *tangent* of α, written $\tan \alpha$;

$\frac{b}{a}$ is called the *cotangent* of α, written $\cot \alpha$;

$\frac{c}{b}$ is called the *secant* of α, written $\sec \alpha$;

$\frac{c}{a}$ is called the cosecant of α, written $\csc \alpha$.

These six ratios are called *trigonometric functions,* because their numeric values depend upon the magnitude of the angle under consideration. Each function of a given angle is a definite fixed number.

Inspection of the right triangle, Fig. 18, will show that the angle marked by the Greek letter β is the complement of the angle α, that is, $\beta = 90° - \alpha$. It can be proven by cutting out the three angles of any triangle in paper and putting the angles together with their vertices, that the sum of three angles in a triangle equals 180°. It can also be proved by putting the two smaller angles of a right triangle together that they equal 90°, whence the correctness of the above statement that $\beta = 90° - \alpha$; in fact in the triangle of Fig. 18 the angle α is equal to the angle β, because we have made originally the side a equal to the side b in this particular triangle as will be remembered from the construction in Fig. 5. Therefore

$$\sin \alpha = \frac{a}{c} = \cos \beta = \cos (90° - \alpha);$$

$$\cos \alpha = \frac{b}{c} = \sin \beta = \sin (90° - \alpha);$$

$$\tan \alpha = \frac{a}{b} = \cot \beta = \cot (90° - \alpha);$$

$$\cot \alpha = \frac{b}{a} = \tan \beta = \tan (90° - \alpha);$$

$$\sec \alpha = \frac{c}{b} = \csc \beta = \csc (90° - \alpha);$$

$$\csc \alpha = \frac{c}{a} = \sec \beta = \sec (90° - \alpha).$$

These relations, however, hold true also for any *acute* angle. An acute angle means any angle between 0° and 90°. Thus the rule: *Each function of an acute angle is equal to the co-named function of the complementary angle.*

Thus any function of an angle between 45° and 90° may be found by taking the co-named function of the complementary angle, which is between 0° and 45°. Co-named means cosine for sine, cotangent for tangent and cosecant for secant. As it is quite a laborious process to determine the functions of angles by measuring, tables of trigonometric functions have been calculated, which read directly for every degree from 0° to 45° by reading from the top down, and for the degrees from 45° to 90° by reading from the bottom up.

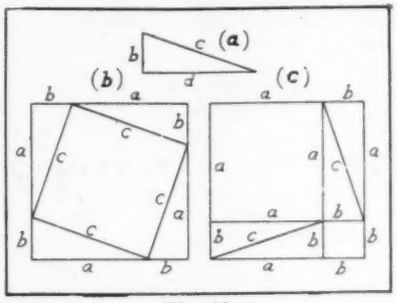


Fig. 19.

We will illustrate the method of finding the functions of the 45° angle as an example. We use again Fig. 18, where the angles α and β are both 45° angles, that is $\alpha = \beta$ and also $a = b$. To determine the relation of c to a and b we make use of the *Pythagorean Theorem,* which states that in a right triangle the square of the hypotenuse equals the sum of the squares of the two other sides (hypotenuse is the mathematical term for the side of the right triangle opposite the right angle). We can express this theorem algebraically by writing it as $c^2 = a^2 + b^2$. This theorem is general in its scope as it applies to any right triangle, the sides a and b do not need necessarily to be equal. The reader can convince himself of the correctness of the theorem by the following construction:

Take the triangle constructed with the sides a, b and c in Fig. 19 (a). Then construct a square having its four sides equal to $a + b$, as shown in Fig. 19 (b). Cut out of a piece of paper four triangles, each one equal to the given triangle, Fig. 19 (a). Place these four triangles in the four corners of the large square, Fig. 19 (b), as indicated, then it will be found that the remaining square has four sides, each one equal to the hypotenuse "c." Consequently this square over c is equal to the square over $a + b$ less four times the given triangle.

Taking again the square over $a + b$ and placing the four triangles upon it as indicated in Fig. 19 (c), two squares will be left uncovered, one having its four sides equal to "a" and the other one equal to "b."

In both Fig. 19 (b) and 19 (c) four times the same triangle has been subtracted from the same square, hence what is left in either case must have the same contents, which means the square over c in the one case must equal the sum of the squares over a and b in the other case, that is, c^2 must equal $a^2 + b^2$.

Having thus ascertained that $c^2 = a^2 + b^2$ and knowing from Fig. 18 that $a = b$, we can write $c^2 = 2a^2$. Extracting the square root we obtain $c = a\sqrt{2}$;

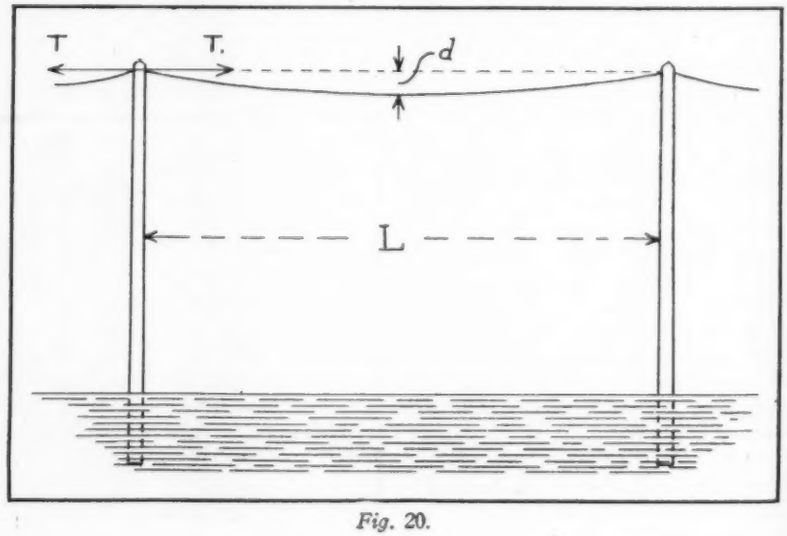


Fig. 20.

hence $\sin 45° = \frac{a}{c} = \frac{a}{a\sqrt{2}} = \frac{1}{\sqrt{2}} = \frac{1}{2} = \sqrt{0.5} = 0.7171$; but it is also $c = b\sqrt{2}$, therefore 0.7171 is also the value for cos 45°;

$\tan 45° = \frac{a}{b} = \frac{a}{a} = 1 = \cot 45°$;

$\sec 45° = \frac{c}{b} = \frac{a\sqrt{2}}{a} = \sqrt{2} = 1.4142 = \csc 45°$.

We have given the most simple example for finding the value of trigonometric functions. Finding the others is more complicated, therefore for practical work tables have been computed. We append such a table, omitting, however, the values for the secant and cosecant, as they are so rarely used that recording them here is superfluous. The table gives also the value of the radians for the angles 0° to 90°. It will be seen in the table that the column of sines from 0° to 45° is the same as the column of cosines from 45° to 90°, therefore, to find the functions of angles from 0° to 45° read from the top down, and to find the functions of angles from 45° to 90° read from the bottom up.

We will not go any deeper into the subject of trigonometric functions at the present time, but will add a few words illustrative of the application of trigonometric functions in line construction.

28. Trigonometry Applied to Pole Lines

The forces acting on a pole by the wires in a straight pole line are balanced, because the same number of wires pull on the pole in the two opposite directions. Any little difference that may exist in the forces is taken up by the elasticity of the pole itself, the pole always being strong enough to take up the compression force acting downward, this force being the pole's own weight and the weight of the wires and cables.

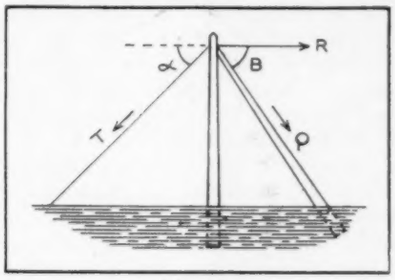


Fig. 21.

As soon as there occurs a bend in the pole line, or the lines start from a pole in different directions, or only part of the wires continue, the forces acting on the pole will not balance any more. The resultant of all forces acting upon the pole can be determined by the parallelogram of forces. For the purpose of calculations all the wires attached to a crossarm can be taken as exerting a combined pull in the axis of the pole. The pull in any direction is exerted horizontally as indicated by T_1 in Fig. 20. This pull must be counteracted by the tension T in the opposite direction. The tension T is determined by the formula $T = \frac{LW}{8d}$, where T = horizontal tension in pounds, d = deflection of wire at center of span in feet, W = load between supports in pounds and L = length of span in feet. This is not strictly correct as the wire from pole to pole is longer than the distance between two poles on account of the sag, but the factor of safety takes care of that.

It is difficult to determine any snow or sleet-load and also the wind pressure. When figuring on sleet and on wind pressure in exposed regions, it must be remembered that when the winds are high snow or sleet has little chance to settle upon the wires. As a maximum wind pressure may be figured at 20 pounds per square foot, which corresponds to about 0.05 times 20 times the diameter of wire per foot of wire.

Having determined the resultant force acting upon a pole by the parallelogram of forces, means must be found for counteraction. The pole may be made strong enough to resist without outside help, or guys may be used.

To learn whether a pole will resist the bending moment, the horizontal stress necessary to break the pole at the ground level must be calculated by the formula $P = \frac{ASr}{4l}$, where A = area of cross-section of pole at ground-level, S = tensile strength of material per unit area, r = radius of cross-section at ground level and l = distance between ground level and center of pressure. This value of P is the breaking weight, therefore a factor of safety of 10 for wood must be allowed.

Whenever local conditions permit, the forces acting on an end or anchor pole and also the forces trying to overturn poles on curves and corners are best offset by guy rods and guy strand; some-

(*Continued on page 27.*)

TABLE OF TRIGONOMETRIC FUNCTIONS

Angle.	Radians.	Sin.	Cos.	Tan.	Cot.		
0°	0.0000	0.0000	1.0000	0.0000	0.0000	1.5708	90°
1°	0.0175	0.0175	0.9998	0.0175	57.2900	1.5533	89°
2°	0.0349	0.0349	0.9994	0.0349	28.6363	1.5359	88°
3°	0.0524	0.0523	0.9986	0.0524	19.0811	1.5184	87°
4°	0.0698	0.0698	0.9976	0.0699	14.3007	1.5010	86°
5°	0.0873	0.0872	0.9962	0.0875	11.4301	1.4835	85°
6°	0.1047	0.1045	0.9945	0.1051	9.5144	1.4661	84°
7°	0.1222	0.1219	0.9925	0.1228	8.1443	1.4486	83°
8°	0.1396	0.1392	0.9903	0.1405	7.1154	1.4312	82°
9°	0.1571	0.1564	0.9877	0.1584	6.3138	1.4137	81°
10°	0.1745	0.1736	0.9848	0.1763	5.6713	1.3963	80°
11°	0.1920	0.1908	0.9816	0.1944	5.1446	1.3788	79°
12°	0.2094	0.2079	0.9781	0.2126	4.7046	1.3614	78°
13°	0.2269	0.2250	0.9744	0.2309	4.3315	1.3439	77°
14°	0.2443	0.2419	0.9703	0.2493	4.0108	1.3265	76°
15°	0.2618	0.2588	0.9659	0.2679	3.7321	1.3090	75°
16°	0.2793	0.2756	0.9613	0.2867	3.4874	1.2915	74°
17°	0.2967	0.2924	0.9563	0.3057	3.2709	1.2741	73°
18°	0.3142	0.3090	0.9511	0.3249	3.0777	1.2566	72°
19°	0.3316	0.3256	0.9455	0.3443	2.9042	1.2392	71°
20°	0.3491	0.3420	0.9397	0.3640	2.7475	1.2217	70°
21°	0.3665	0.3584	0.9336	0.3839	2.6051	1.2043	69°
22°	0.3840	0.3746	0.9272	0.4040	2.4751	1.1868	68°
23°	0.4014	0.3907	0.9205	0.4245	2.3559	1.1694	67°
24°	0.4189	0.4067	0.9135	0.4452	2.2460	1.1519	66°
25°	0.4363	0.4226	0.9063	0.4663	2.1445	1.1345	65°
26°	0.4538	0.4384	0.8988	0.4877	2.0503	1.1170	64°
27°	0.4712	0.4540	0.8910	0.5095	1.9626	1.0996	63°
28°	0.4887	0.4695	0.8829	0.5317	1.8807	1.0821	62°
29°	0.5061	0.4848	0.8746	0.5543	1.8040	1.0647	61°
30°	0.5236	0.5000	0.8660	0.5774	1.7321	1.0472	60°
31°	0.5411	0.5150	0.8572	0.6009	1.6643	1.0297	59°
32°	0.5585	0.5299	0.8480	0.6249	1.6003	1.0123	58°
33°	0.5760	0.5446	0.8387	0.6494	1.5399	0.9948	57°
34°	0.5934	0.5592	0.8290	0.6745	1.4826	0.9774	56°
35°	0.6109	0.5736	0.8192	0.7002	1.4281	0.9599	55°
36°	0.6283	0.5878	0.8090	0.7265	1.3764	0.9425	54°
37°	0.6458	0.6018	0.7986	0.7536	1,3270	0.9250	53°
38°	0.6632	0.6157	0.7880	0.7813	1.2799	0.9076	52°
39°	0.6807	0.6293	0.7771	0.8098	1.2349	0.8901	51°
40°	0.6981	0.6428	0.7660	0.8391	1.1918	0.8727	50°
41°	0.7156	0.6521	0.7547	0.8693	1.1504	0.8552	49°
42°	0.7330	0.6691	0.7431	0.9004	1.1106	0.8378	48°
43°	0.7505	0.6820	0.7314	0.9325	1.0724	0.8203	47°
44°	0.7679	0.6947	0.7193	0.9657	1.0355	0.8029	46°
45°	0.7854	0.7071	0.7071	1.0000	1.0000	0.7854	45°
		Cos.	Sin.	Cot.	Tan.	Radians.	Angle.

The Ground Connection—Important and Neglected

By RAY BLAIN

In the old days of the ground return, before inductive disturbances from the power and light company lines forced the metallic circuit into popularity, great care was exercised by all telephone companies to obtain as near a perfect ground as possible in order to insure good transmission. However, in recent years, with nearly everything metallic, the ground connection not having any effect on the talking circuit, its chief function being that of protecting equipment and persons from excessive electrical potentials, it has not lost any of its importance, as many seem to believe it has.

It is surprising in a number of cases, where telephone companies will spend good money for lightning arresters, and then, presumably in the interest of economy by not installing an adequate ground connection, destroy their effectiveness, I have often found sub-station protectors and protected terminals without any ground connection whatever, others where the ground consists of only a piece of iron wire pushed into the earth from eight to eighteen inches. With these conditions the same companies were complaining of an excessive amount of damage due to lightning and that certain types of arresters were not effective. The best protector built will not function without a suitable ground wire and ground connection.

Recently I had occasion to visit a resort in the Philippines 53 kilometers from Baguio in the Mountain province of Benguet, up in the Igorote country. There I found that the earth connection plays an important part in the transmission of the telephone system due to a metallic circuit being both expensive and difficult to maintain and that electrical inductive disturbances are unknown. Like all telephone men, even though on a vacation, I kept a close watch on the telephone line as we went up the trail. I noted that the insulators were fairly good; the line free from trees, and due to the fact that all spans were long, some over 1000 feet, the joints were all well made mechanically to stand the strain and were consequently all good electrically. Considering all of this the transmission should be fairly good during dry weather and in the rainy season nothing matters much in that particular region except that they have an ample supply of chow. Upon arriving at the resort I noticed a magneto telephone of a well-known American manufacture on the wall and it was like meeting an old friend. I took down the receiver and heard a conversation faintly. The American in charge of the resort stated that it never was any better. He also stated that he was going to purchase six new dry cells and connect them all to his instrument in hopes that he could hear better. I advised him against this and an inspection of the instrument disclosed that it was O. K. and that the transmitter came up with the two practically new dry cells connected to it. However, an inspection of the ground connection disclosed the fact that it consisted of only a piece of No. 9 galvanized wire pushed into the earth eleven inches. This type of a ground connection 8000 feet above sea level would even be less effective than at lower elevations. I advised him how to construct a suitable ground that would eliminate his trouble, but I had to leave before he had time to carry out my advice.

The office ground on a telephone system should be considered first in importance, to this ground one side of the storage battery in a common battery exchange is connected for protection, also the main frame protectors, one side of the power ringer circuit, and usually the frames of the generators and other power machines. A very good office ground can be constructed by connecting two copper plates about 24 by 36 inches in parallel and burying them from four to six feet beneath the surface. The depth to bury the plates will be governed to a certain extent by the nature of the soil, but seldom will a depth of over six feet materially decrease the resistance of the ground connection. Any sheet metal can be used for the plates but copper is the most durable. Galvanized iron is very good, and while not as durable as copper, if a sheet of a medium of heavy thickness is used will last almost indefinitely.

The plates, regardless of the type used, should always be set on edge. The reason for this is that the low resistance of the ground connection depends to a great extent on a good contact by the earth on all parts of the plates surface. If the plates are laid flat on the bottom of the hole the earth will gradually settle away from the under side and lose contact with the plate in spots. Whereas if the plates are set on edge, the earth when it settles will only make better contact with all of its surface.

It was formerly considered necessary to bury a quantity of charcoal with a ground of this type. The theory was that it would store up a quantity of moisture during the wet periods and expel it during dry ones, keeping the connection moist and the resistance of the ground connection nearly constant at all times. This theory is now considered by many to be in error as exhaustive tests have shown that charcoal will not absorb a larger quantity of moisture than a similar volume of earth and will not retain it longer. If the ground connection is salted its resistance will be lowered, but it likely will not have a noticeable effect on keeping the resistance constant. Salt will be gradually lost through seepage and to retain its effect, quantities will have to be added at periods ranging from one to three years, depending on the nature of the soil. The salt will be carried away much faster in a country with a heavy rainfall, also faster in a coarse loose soil than in clay or any soil that packs well.

The wire connecting the plates with the apparatus should be of a size adequate to carry any current that may be required of it. There is no danger of getting this wire too large, as it helps keep down the resistance of the connection. Grounds of this type constructed with care have been known to have a resistance as low as three and four ohms. There are several patented ground connections on the market that are very effective and are much easier to install than the plates mentioned above.

Sometimes, especially on office grounds, it is suspected that the regular ground is of high resistance and an effort is made to improve it by connecting with it the water pipe, steam pipe, gas pipe, and everything else that has an earth connection. All of these located at different distances will have different impedances and in many cases it will be found that the overall resistance is much greater than the best one of the group when used alone. If parallel grounds are to be used they should always be identical and spaced an equal distance apart.

For the ground connection at the subscriber's station a good ground rod will usually be found sufficient. This rod ordinarily should not be smaller than ½ inch by 5 to 6 feet in order to get

the required contact surface between metal and earth. The rod may be either black iron or galvanized. The iron rod is just as good electrically as tests have proven that a rusty surface does not increase the resistance to a noticeable extent. Rods of all types should always be clean when installed. Grease, paint or any similar substance will cause them to make a faulty connection with the earth and a high resistance ground will result. Due to their being much more durable, the galvanized iron rod, or better yet the copper clad rod is cheaper in the long run.

The rod should have a piece of No. 12 annealed copper wire about two feet long sweated onto the top end for the purpose of making connection to the ground wire. The ground wire should be of No. 14 copper, rubber insulated, and in one piece without joints. To insure a good connection between the ground wire and the wire on the end of the rod a special sleeve to fit a No. 12 wire on one side and a No. 14 on the other will be found very good and convenient to use. The rod should be driven into the earth for at least its full length.

The ground rod should always be driven into the ground at least 14 inches from the wall or foundation, as this insures a clearance from filled earth which usually contains rocks, and locates the rod under or near the drip from the eaves and in the moist earth. The ground wire should be well protected from mechanical injury at the earth's surface and for about two feet on the side of the building. Wires not properly protected at this point may become broken in a short time and probably not noticed until the equipment is damaged by lightning.

The ground wire should be run as direct as possible from the protector to the ground connection. All bends should be avoided if possible and no turns made sharper than a right angle. When possible a round turn should be made in preference to a right angle. Always run ground wire in the open and never through metal conduits or iron pipes. Never run ground wire near or across light or power wires or over metal conduits or pipes if it can be avoided. If the crossing of light wires or conduits cannot be avoided see that the ground wire is well protected with porcelain tubes or some other ample protection.

A cold water pipe usually makes a very good ground connection for a substation protector if a ground clamp is used and properly installed. Never attempt to solder a wire to a cold water pipe with the pipe full of water. Steam and gas pipes are not recommended to be used for any type of a ground connection, due to the fact that they have many high resistance couplings usually and make poor contact with the earth. Gas meters also usually insulate the piping inside a building from that in the street. Pipe must always be thoroughly cleaned before a ground clamp is installed. If a pipe is very dirty it should first be scraped with a file or similar instrument and then thoroughly cleaned with sand or emery paper. Always place a ground clamp where it is not exposed to mechanical injury. If a pipe suspended from the ceiling is used, always place ground clamp near a support.

Regardless of the type of ground connection used, or for what purpose, extreme care must be taken to see that the ground wire makes good connection with it, and is run properly with all connections good electrically. If grounded properly protectors will function as was intended. Money expended on good protectors and ground connections is only cheap insurance on expensive equipment.

Cooper, Ohio Chief, with A. T. & T.—Carter Advanced

Cleveland, O.—C. P. Cooper, who had the distinction of being one of the country's youngest executives at the head of a great corporation, has resigned as president of The Ohio Bell Telephone company, to become a vice president of The American T. & T. company. The change became effective August 24, when the board of directors of The Ohio Bell

C. P. Cooper

acted on Mr. Cooper's resignation and selected Mr. Carter to succeed him.

Mr. Cooper, who entered the telephone industry in 1908 as a junior engineer for The New York Telephone company, succeeds Edgar S. Bloom as a vice president of The American T. & T. company. Mr. Bloom recently was made president of The Western Electric company. Mr. Cooper's work in the development of The Ohio Bell Telephone company made him an outstanding figure in the Bell system. In the short time he was its president, the company made rapid strides towards a place in the front ranks of the associated Bell companies.

Mr. Carter, the new president, has been in the telephone industry since 1900 when he went with The Bell Telephone Com-

Edwin F. Carter

pany of Missouri as an inspector. He has held several important posts with The Southwestern Bell Telephone company, having been general commercial manager when he was made vice president last March.

Omaha, Neb.—New offices and warehouses for the Omaha branch of the Graybar Electric Company will be occupied November 1. The new Omaha quarters, consisting of a two story structure and basement, will be located at 1122 Capital avenue.

Chicago, Ill.—Walnart Electric Co., 308 South Green street, has been appointed central states sales representative by the General Insulate Co.

Theory of Electricity

(Continued from page 25.)

nitude); the guy is to take up this pull; the tension acting in the guy is designated in the figure by T, the arrow indicating its direction; the angle formed by T and the force counteracting the pull R is marked α, then $T = \frac{R}{\cos \alpha}$; or in case of the brace, the compression $Q = \frac{R}{\cos \beta}$, where β represents the angle between the brace and the resultant R.

Most guy rods are made of wrought iron. The diameter of the rod is found by dividing the tension T by 12,000 (12,000 pounds being the tensile strength of wrought iron per square inch), thus obtaining the area of cross-section, from which the diameter is determined by the formula: Area $= r^2\pi$.

These Methods Collect from Service Lines

An editorial in the August number of TELEPHONE ENGINEER referred to the problem of making collections from farmer owned and operated lines which receive switching service from commercial companies. At the close of the editorial, comment was invited from companies which had found a solution for some of the difficulties. That the editorial referred to a live subject was evident from the number of unsolicited letters which came in. So many good ideas were given that we are reproducing a number of these letters in the form of a symposium which will well repay careful reading by managers who are still struggling with this situation.

The first correspondent to "come to bat" was our old friend and contributor, P. Kerr Higgins, whose articles have been discontinued temporarily due to the author's vacation trip to the Bermudas. As usual, Mr. Higgins has something practical to suggest in his letter which follows:

"Noting your editorial on collections in August issue, it might interest your readers as to how collection on service lines are usually made in Missouri.

"The Public Service Commission of Missouri has ruled that service lines must pay for the whole line and six months in advance. While the telephone companies have no authority to organize these service lines, every effort is made by the companies to have this done. In this way the telephone company deals only with the secretary of the service line sometimes known as a switched line. The line is held strictly responsible for the payment of every station in the line and part payments are refused absolutely. Line is disconnected if *full* payment is not made. In this way we have no trouble with payments on switched or service lines, in fact much less than on lines in the county owned by the company. Only one account is kept for each line and that is with the secretary of the line. I am enclosing a copy of the public service commission order and also a sample constitution and by-laws which some of our switched lines and companies use."

The ruling of the Missouri commission referred to is found in Case No. 1504 as follows:

"Approval of the rule of protestant to require execution of its written contract will be denied, but in lieu thereof each rural line desiring switching exchange with the protestant will be required *in advance to collectively semi-annually pay* the switching rentals upon the whole of said rural line. The protestant will not be required to switch any rural line until such advance payment has been made."

The model form of constitution and by-laws for the mutual line company is too long for reproduction but those interested may obtain copies.

Closely following the preceding letter came one from Mr. Fred L. Sears, manager of The Cambridge Home Telephone Co., Cambridge, Ohio.

"We have been much interested in your article in the August number of TELEPHONE ENGINEER, entitled 'Collecting From Service Lines.'

"In our exchanges we remedy the difficulties enumerated as follows: We make our collections quarterly on this particular class of service instead of monthly, which reduces the accounting and collection expense to about the same per dollar as for other subscribers who are billed monthly. In some cases we have the rental for all subscribers on a line collected and paid to us by the line treasurer.

"In connection with delinquent accounts, we disconnect the whole line for the non-payment of one subscriber account, as it is a mutual affair and we deal directly with the farmer company rather than the individuals. We first notify an officer of the farmer company in advance of service interruption in the same routine which we use for our regular subscribers. This plan was adopted by us but a few years ago, but has proven not only much more satisfactory to our own company but is greatly preferred by the farmer companies as well.

"Regarding 'the individual on the service line who says that he does not use the switching service and, therefore, refuses to pay the switching charge' we have 'no such animal' in our exchanges. Our regulation provides that every switching subscriber connected to our switchboard must pay the switching charge, or rather the switching company (or farmer line) is responsible to us for the payment of every member connected to the line. If any subscriber wishes to stay on the line but not use the service through the central office we require that he be immediately disconnected from the line. There is absolutely no question about the company's right to maintain such a regulation and the plan has worked perfectly for us."

Our next letter came from S. D. Crowe, secretary and general manager of the Home Independent Telephone Co., operating a system of ten exchanges with several thousand subscribers in the northeastern corner of Oregon, the main office being at LaGrande. Mr. Crowe writes as follows:

"Referring to the enclosed article taken from the August TELEPHONE ENGINEER, we wish to suggest our plan of handling these service lines.

"'In all cases where the company connects with a line owned and maintained by the various subscribers upon that line, the company furnishing only central switching service and maintenance of lines within the city limits, no instrument may be connected to such a line within the prescribed radius of the particular central office exchange area, except upon the same terms and conditions as all other subscribers within such radius pay for the same service. The company has the right, in every case, by refunding the unexpired amount of any advance payments already made for service on any such line, to cancel any agreement entered into for service upon or connecting with such a line, or to discontinue service where no written contract exists, at any time that any of the regulations of the company are broken by any subscriber attached to such a line or circuit or those claiming under any such subscriber.'

"The above paragraph is a quotation from our rate schedule which covers this class of service. You will find upon reading this section from our rules that our company reserves the right by refunding any prepaid rentals to cut off any entire line if one member of that line fails to meet the conditions agreed upon unless the members of the line will cut such an offending member off.

We have found that our practice is entirely successful and we have very little trouble from this class of subscribers, although we have quite a large number of them connected to our various exchanges. We do feel, however, that our lack of trouble is due to our ability to disconnect any entire line since we do occasionally have to notify the members of a line about some unpaid account."

A very interesting letter came from

A. H. Dreyer, manager of the Starbuck Tel. Co., Starbuck, Minn. A reading of it will convince that Mr. Dreyer went about the job in a positive manner and got results:

"In your August number of TELEPHONE ENGINEER I read with much interest your article under the heading of 'Collecting from the Service Lines.' Since you asked for opinions of companies who have worked out a better system I am taking the liberty of telling you and other telephone people who are having the trouble that you mention. We have had the same trouble as stated in your article, but have long since gotten away from it, and we have no one to blame for the trouble that we had but ourselves for not putting a better system into effect.

"We all know that each one of those small farm lines have a set of officers or board as they are sometimes called. Well then, Mr. Manager, call them into your office or go out to their meeting and lay down your cards face up, and tell them that you are having too much trouble in collecting accounts from their subscribers, and that in the hereafter you will not deal with any individual, but that you will deal with the officers of their company; that they are to be responsible to your company for the switching fees, that you will want them paid up in advance each six months; that you will render their secretary a bill of all tolls used by their subscribers, and that they must send you a check for the total amount of toll bill on or before the 15th of the following month. Just what I thought you would say, 'It can't be done.' But I say it can be done if you are not one of those weak managers who takes orders from the office girl. We have done it for the past six years without trouble; only a bit of kicking on the start, but you must be big enough to stand a bit of back-bitting. Why should you run their business? They are elected by the share-holders of their company to run the line and the business connected therewith, and yet so many managers undertake to do the collecting for them. I have not only put over the above deal, but I have them understand that they must keep their lines in good working order or they will be cut off from our board, and I have cut some of them off, with the result that lines are working all the time.

"Now, Mr. Manager, just try out this idea I have given you, and if you do not weaken you will have your office force a lot of unnecessary work, and you will not hurt your good will either if you go about it in the right way, but you must be firm and have a stiff upper lip and keep it stiff."

Another Minnesota telephone company that has had to work out a solution of the problem on quite a large scale is the Blue Earth Valley Telephone Company, of Blue Earth. Mr. W. A. Eckles gives his experience as follows:

"In your August issue you invite comment on the difficult phase of the collection problem when applied to farmers' mutuals where the commercial company merely furnishes the switching.

"The company I represent switches a little over 1100 farmers' mutual telephones on lines with from five to twenty-five subscribers.

"Outside of the fact that the service is not always what it should be on account of overloaded and poorly maintained lines our relations with the farmers are very pleasant and satisfactory and we make 100 per cent collections.

"We simply follow the usual custom in this part of the country and insist on treating them as independent companies and hold them collectively and not individually responsible. We help them make out their tax reports, sell them construction and repair material at actual cost to us and repair their instruments at actual cost for labor and material.

"But when it comes to toll and switching we treat them the same as the Bell companies treat us; that is, as a unit and not as individual stockholders. We send out our bills promptly and expect prompt payment. If payment is not made in a reasonable time we call the officers' attention to the matter. If this does not bring a settlement the chief operator tells them that she has orders to cut off all lines that are not up with their toll and switching fees and that until further notice their line will be plugged off during the day time but that night service will be given pending settlement.

This always has the desired effect. The treasurer tells his company that he will pay up and get them service as soon as they give him something to pay with and of course no one wants to be the means of keeping his neighbors from getting telephone service by refusing to pay his dues.

One or two lessons is generally enough and the line will make some arrangements whereby the treasurer has money to pay the 'central dues.'"

It scarcely seems necessary to comment on these letters. As Mr. Dreyer says in his letter, "It can be done," and the manager who has trouble with collections from the service lines will have no one but himself to blame if the condition continues. The way has been pointed out and all that is needed is the inclination and the moral courage to follow it.

Washington, Ia.—There's a lot of cable work being done in the Independent telephone field in Iowa, according to F. J. Seamon, manager of the Reliable Construction Co. The Reliable company specialized in cable work and handles a large volume of this class of business.

OUR LITERARY DIGEST

Review of Recent Publications on Telephony and Allied Subjects

The Financial History of The American Telephone and Telegraph Company, by J. Warren Stehman. Hart, Schaffner and Marx Prize Essays on Economics, Houghton, Mifflin Co., Boston and New York.

The present volume was submitted in the Hart, Schaffner and Marx Prize Essay Competition in 1922 and received honorable mention. In a book of over 330 pages the author has traced the history of the financing of the American Telephone and Telegraph Company, its predecessors and its subsidiaries, from 1876 to 1922. The history is divided into periods; invention and early financing, 1876-79; monopoly period, 1880-1893; competitive period, 1894-1899; period of expansion, 1900-1907; rounding-out period, 1908-1916, and war and post-war period. There are also sections on the present financial structure of the Bell System, on Government Regulation and on Problems disclosed by the study. The material is drawn from a wide variety of sources, including the Commercial and Financial Chronicle, annual reports of the various units of the Bell System, public service commission and other public reports and decisions, and a large number of miscellaneous publications.

While it is clear that the author has a great admiration for the company and the manner in which its financial operations have been carried on, this does not prevent his criticising where criticism is due, notably the case of the attitude of Bell officials during the monopoly period. Not every one will agree with his conclusions in all cases, particularly when he refers to the division of territory with non-controlled companies on page 193, but in the main, the conclusions have been drawn carefully and dispassionately. The book forms a valuable addition to the history of the industry.

Beginning in the October

TELEPHONE ENGINEER

A series of valuable telephone data and reference information compiled by

John B. Rathbun

Insulation Test Switch for Automatic Exchanges

By A. M. BRILL

Automatic Inspector, Tri-State Telephone & Telegraph Co.

As automatic telephone service is rapidly becoming more popular, the problem of proper maintenance at a reasonable cost is of interest to all automatic telephone men, and any device that will lessen their daily routine testing and inspection of the central office equipment is always welcomed at automatic exchanges.

Every relay, switch-frame, and unit-frame, is insulated from each other, and from the cable run-way (which is grounded). Periodic insulation tests are made to see that they are insulated from each other, and from negative or positive battery, which may get on the frames, or relays, from a coil, screw, or spring assembly. Several tests must be made on each piece of this equipment, which consumes considerable time and expense.

I have made up an insulation test switch from equipment found in most every automatic exchange, and have tested it out for several months. It is a great time saver as all of the above tests can be made in two operations. This insulation test switch will give constant supervision on several boards or bays temporarily connected together, and will give a signal, through the regular office signal system, if negative or positive battery comes on the bays or boards under supervision; and this often happens on boards when certain line-switches use a certain trunk and only remains on during the time of the telephone call on that particular trunk.

This insulation test switch catches these temporary crosses, which would probably never be detected in any other way.

The method of using the test switch is as follows:

Place test switch in a vacant switch position, in the board or bay to be tested; if there is no vacant switch position, use an adjacent board or bay connecting the frames together by a cord.

If positive battery is on the frame of the board or bay under test the "red" lamp will glow, and the buzzer will operate.

If negative battery is on the frame the white lamp will glow, and buzzer will operate.

The negative battery to these lamps flows through the release supervisory relay which gives the alarm through the regular office signal system. The snap switch cuts off all the signals; except the buzzer which stays on until the cross is removed.

To test for relays, or switch frame, crossed with board or bay:

Use test-lamp or cord connected to negative or positive battery; touch each relay and switch frame. Signal will be received if crossed.

To test for relays or switch frame crossed with negative or positive battery:

Use test-lamp or cord connected to frame of board or bay; touch each relay and switch frame. If crossed with negative battery, white lamp will glow; red lamp will glow if crossed with positive battery.

Several boards or bays can be supervised constantly by connecting their frames together. A different group of boards or bays can be supervised each week.

"C" and "D" are 7,850 ohm relays. (Not less than 5,000 relays should be used.)

"A" is an 8-c. p. 48-v. carbon signal lamp (white).

"B" is an 8-c. p. 48-v. carbon signal lamp (red).

"E" is a high resistance buzzer.

"F" is a snap-switch.

"G" part of the regular switch jack. (Ground and private jacks.)

"H" part of the regular switch jack. (Release battery jack.)

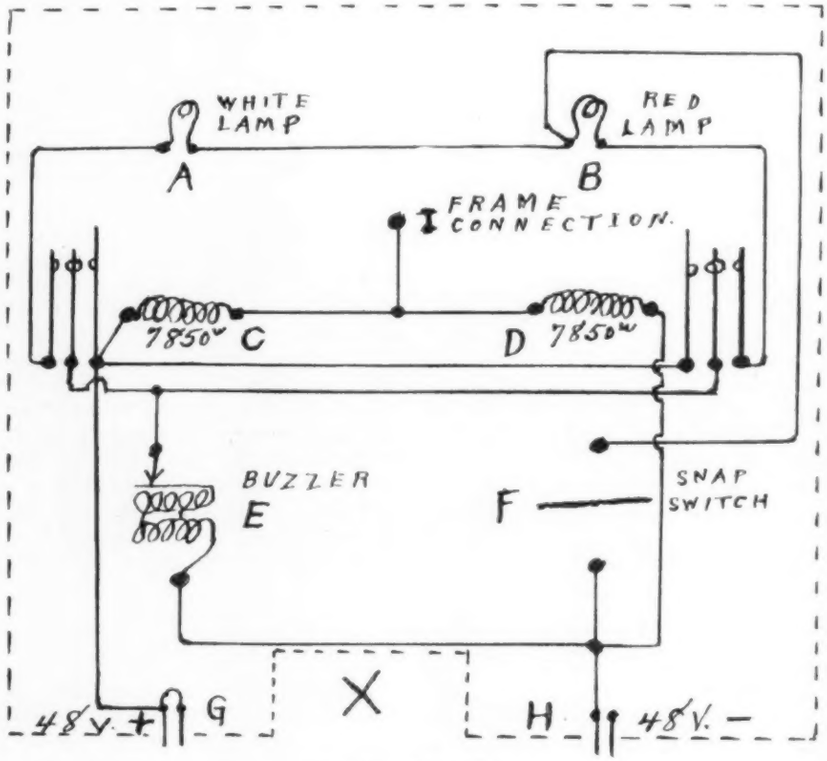
"I" is a wire connected to the frame of the switch.

Dotted line is a selector or repeater switch frame, on which the above equipment is mounted.

"X" is a portion of the frame and jack cut out to clear the bank holders in vacant switch positions.

Adjustment of "C" and "D" relays:

Residual	.015
Stroke	.015
No. 1 and No. 2 springs make on.	.010
No. 2 and No. 3 springs make on.	.006
Operate through.....Ohms	3,000
Non-operate through.....Ohms	4,000



Insulation Switch Test.

Relay Operation, Testing and Maintenance

Relays are an important part in all common battery telephone systems. They may be described as switches operated by electromagnets. The switch may cause a current to flow through a secondary circuit to perform a certain work such as lighting a line lamp. Some relays open one circuit; others close one, while still others may both open and close several, with one operation. In some circuits the sequence in which the contacts are opened and closed forms an important factor.

The characteristics of the winding is governed by the circuit in which the relay is to be connected. The magnet pull or the strength of the magnet is determined by the amount of work that the relay is required to perform, and work may be defined as opening and closing contacts. The product of the current passing through the coil, multiplied by the number of turns on the coil, gives the ampere turns. Therefore, the strength of an electromagnet is governed by the number of turns in its winding, and the current flow through it. The limit is established by the carrying capacity of the wire and to a certain extent by the shape, amount, and quality of iron in its core.

When a relay is to be connected in series in a circuit, the current flow is usually high, and a wire of sufficient size must be used to carry it without overload. The coil is wound with a small number of turns necessary to give the required number of ampere turns to perform the work required. When a relay is to be bridged across a circuit, the current that is shunted through it will be small, so the wire of the coil must be correspondingly small in order to permit the winding of the large number of turns required to give the ampere turns necessary to operate the armature.

In some cases a relay is required in a circuit that must perform a certain amount of work, even though the current flow is very small. To construct a relay of the single wound series type, with the large number of turns necessary due to the limited current flow, to operate it, would increase the resistance of the circuit to an objectionable point. This difficulty is overcome by winding the relay double, that is two separate windings in parallel, both wound in the same direction. This arrangement gives the same magnetic effect with only half the resistance of the straight series wound type. When it is necessary to have a relay in series with a talking circuit, and to avoid serious transmission losses, the relay is wound with a large number of turns of fine wire and then shunted by a non-inductive resistance which acts as a by pass for the greater part of the talking current, as the coil acts as a high impedance to the high frequency talking currents. Sometimes a relay is wound with two separate windings on the same core. Both windings are identical and wound in the same direction. This arrangement gives the relay two separate operating features.

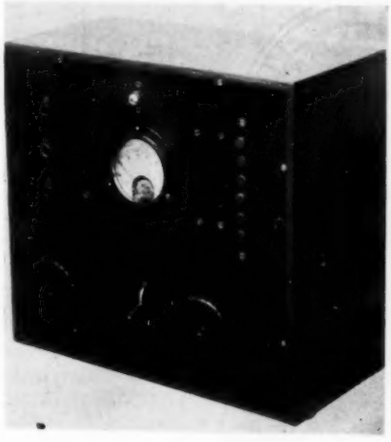


Fig. 1.

Sometimes one winding is used to attract the armature and the other in a later operation to release it by passing current through the second winding in the reverse direction from the first which

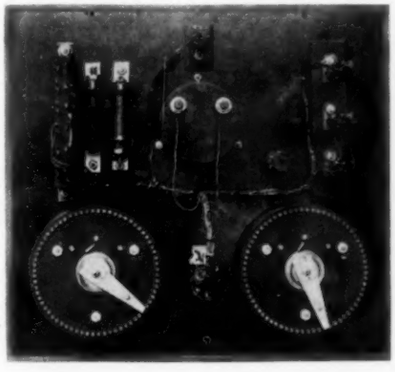


Fig. 2.

will neutralize the magnetic effect and cause the armature to release.

Current Flow Method of Adjustment.

Too often, the method of relay adjustment is by guess, that is if a relay fails to operate the spring is examined, bent slightly and the circuit tried,—if the relay operates it is called OK. Then later on some particular combination of circuits, low battery voltage, or for any other reason the relay does not receive the full current flow that it did on the test, it fails to operate. The adoption of a current flow method of adjusting relays to margins specified by the manufacturer will eliminate a lot of trouble and will probably lengthen the life of the relays. The adjustment of relays on the current flow method is very simple although many seem to think otherwise.

A Relay Test Set.

The test set used for making adjustments on current flow consists primarily of a variable resistance and a milliammeter connected in a series with the winding of the relay under test. The current as shown by the meter is varied by adjusting the resistance. When the proper current is indicated on the milliammeter the relay is adjusted by using three different current values: operate, non-operate, and release. The operate current causes the relay armature to pull up, the non-operate not to pull up, and on the release when pulled up to fall back. With this arrangement a relay under test will receive the most extreme conditions that it would ever receive in actual usage.

Line relays and cord supervisory relays are both expected to operate equally well on long or short lines; also they are expected not to operate on lines of low resistance or lines with a high resistance short. Take for example one type of relay on subscribers lines is supposed to operate on .0058 amperes and to release on .0024 amperes. The operating current represents the mean of the longest and shortest line, the release current represents the low insulation of the line and the high resistance short, because .0024 amperes will flow through the winding without actuating the armature. Fixed resistances may be made up and used to limit the current flow through each relay to the current amount for adjusting it. But at best this method is only approximate as many times when testing through the circuit from the switchboard a high resistance joint will reduce the current flow and if there is no meter it cannot be detected.

The outward appearance of a current flow relay test set is shown in Fig. 1, and the rear of the panel is shown in Fig. 2. This set can be built locally with no more difficulty than the construction of a

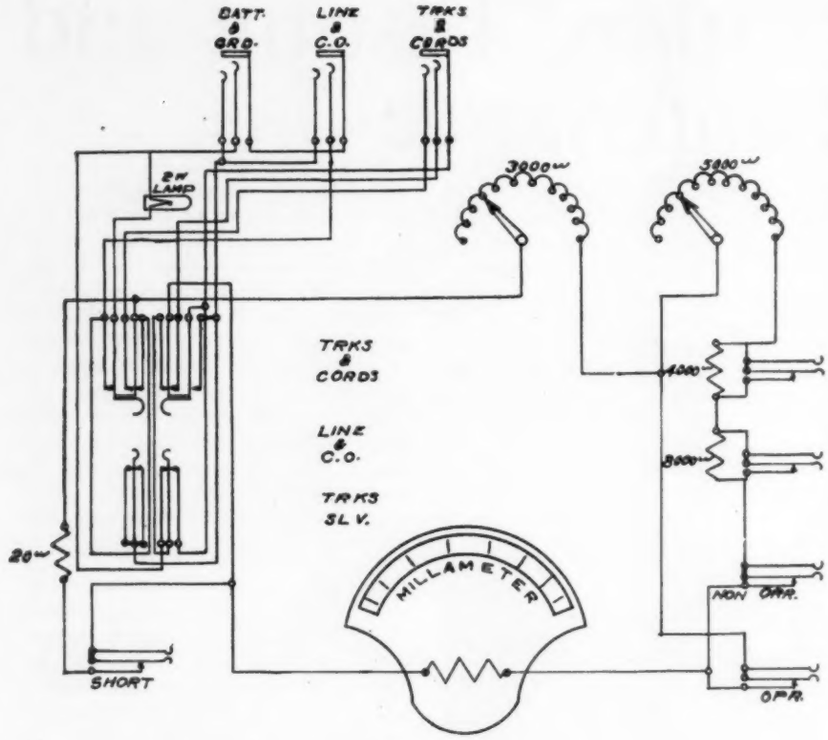


Fig. 3.

simple radio receiving set and with much less expense. This set is very similar to one used by some of the larger telephone companies, but must be built specially since, to the best of my knowledge, there is no such set on the market and I have tried on various occasions to purchase one. This set may appear to be complicated at first glance, but after tracing out the circuit which is shown in Fig. 3, it will be found to be very simple.

In the construction of the set the first thing to consider is the box or case which should be as small as the apparatus used will permit. The material required, outside of the parts which are usually available around the telephone exchange, can be purchased at a small cost from any radio supply house. The panel should be bakelite and about ⅜-inch thickness. The two 5,000 ohm variable resistances may be potentiometers of the radio type. The two fixed resistances of 4,000 and 8,000 ohms are of the non-inductive type so common in small radio transmitters.

The type of jack used will depend on the type of equipment the set is to be used with as the switchboard plugs must fit them. If one test set is to be used on two different types of switchboards, duplicate jacks may be installed. The key is special but can usually be made up from a ringing and listening key by rearranging the springs. The milliammeter should be of a good panel mounting type and two scales is to be preferred. The high scale should read from about 0 to 150 or 200 and the low from 0 to 10 or 15. The low scale should be divided into tenths, in order to make accurate settings on the low adjustments, such as .0024 amperes which is 2.4 milliammeters. The low scale of this type is very desirable but not absolutely necessary.

The push buttons can usually be picked up around the exchange or can be purchased at a small cost. Order wire buttons can be used but the ones for short circuiting the fixed resistances must have some means of locking down.

How the Test Set Operates.

The use of the test set is a very simple matter after the connection has been made to the relay to be tested, by one of the methods described later. First hold down the operate button and adjust the rheostat until the meter indicates the proper current flow specified for the operation of that particular relay. By pressing the operate button now periodically the relay should operate and release. Next hold down the non-operate button and adjust the other rheostat until the meter indicates the specified non-operate current. If the range of the rheostat will not permit the proper current flow on the non-operate adjustment the fixed resistances should be cut in or out, one at a time by the locking keys. Relays should now be adjusted on the operate and then the non-operate button pressed without the slightest movement or chatter of the armature.

When a relay is to be tested which has a release current specified instead of a non-operate, the first thing to do after the set is connected is to lock down the non-operate button and adjust the rheostat until the release current is indicated on the meter, and with this button still locked down, press the operate button and adjust the other rheostat until the meter indicates the operate current. Now when the operate button is pressed and released the current is automatically reduced from operate to release.

The manufacturer of your equipment will be glad to give you a table of adjustments for your relays. It is usually considered good practice to exceed these margins slightly when possible to offset any slight variations later. To elucidate this suppose a certain relay is to operate on .060 amperes and release on .027 amperes, the actual adjustment should be about .058 on the operate and .029 release. When saturation is specified for a relay it should be saturated on the specified current and then reduced quickly to release. When a saturation current of over .150 amperes is specified use the short key on the test set if the resistance of the relay and the current is not so low as to permit a current flow of over 1½ amperes. Saturation may be defined as that state of a magnet when it has reached its highest state of magnetization.

Circuits for Connecting to Test Set.

The nature of the circuit in which the relay to be tested is located will govern to a certain extent the method of connecting the test set. A few circuits which are usually very similar in all makes of equipment will be considered here and methods mentioned will usually be found satisfactory, if not a slight change such as reversing the tip and ring will usually remedy the difficulty.

When testing line relays from the relay rack a test cord as shown in Fig. 4-C should be used. Place the test clips on the springs (tip and ring) of the cut off relay. Place plug of test cord in "Trunks & Cords" jack of test set and throw key to "Trunks & Cords" position and test relays in the regular manner. After the relays have all received an initial adjustment from the relay rack on the specified margin, they should be given a check test once or twice per month to make sure that they are retaining their adjustment. As only an occasional relay will need adjustment on the check test, they can be covered much faster if some rapid means of connecting is devised. This can be accomplished from the switchboard by using a cord shown in Fig. 4-B for checking the line relays. Place one plug of cord in answering jack under test and the other in "Trunks & Cords" jack of the test set and throw key to "Trunks & Cords" position. The flash of the line lamp when the operate button is pressed will indicate the operation of the relay. The relay should be adjusted until the lamp will flash about twice per second and with a snap. A

slow flashing lamp will indicate a sluggish relay.

When adjusting cut off relay from the relay rack, the cord shown in Fig. 4-C should be used. Connect one test clip to one side of the winding and the other to battery. If the milliammeter shows a reverse reading when the operate button is pressed change the clips. Place plug of cord in "Trunks & Cords" jack of test set and throw key to "Trunks & Cords" position. In making the check test of cut off relays from the switchboard the test cord shown in Fig. 4-A should be used as indicated in Fig. 5. The plug which is connected to the single ring conductor should be plugged into "Line & C. O." jack of the test set; the plug with the red shell into answering jack under test, and plug with black shell into any answering jack. Next plug any subscribers cord into "Battery & Ground" jack of test set and throw key to "Line & C. O." position. Both line lamps should now be lighted and by pressing the operate key both should be extinguished. Failure of the lamp under test to flash at least two times per second will indicate that relay is not operating properly. If the line lamp does not relight after releasing operate button it indicates that contacts do not make on cut off relay. To adjust cord supervisory relays from the switchboard, plug cord to be tested into "Trunks & Cords" jack of relay test set and throw key to "Trunks & Cords" position. Plug any subscribers cord into "Battery & Ground" jack. The lamp on the cord being tested should not be lighted and is extinguished by pressing the operate button.

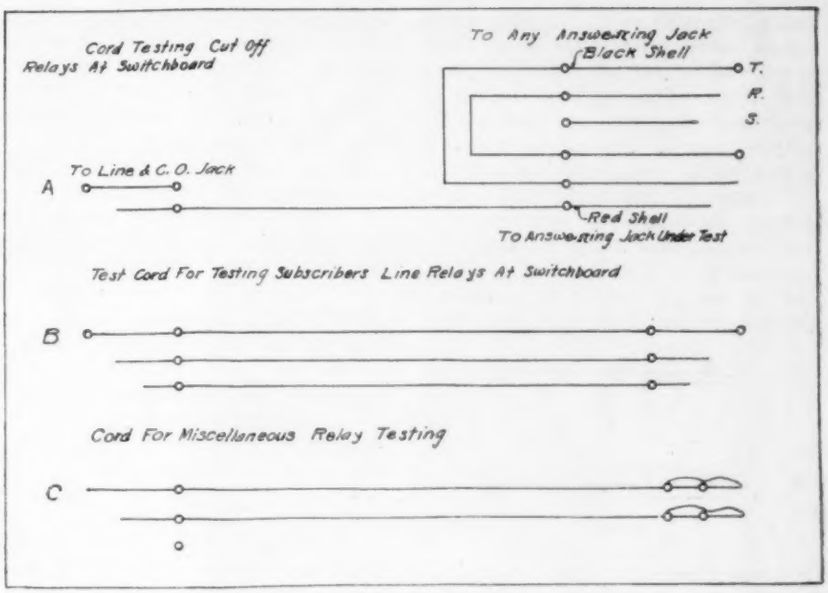


Fig. 4. Various Testing Cords.

Line Lamp Tests.

The test set can also be used for testing for high resistance line lamps in the following manner: Cut all resistance in on the operate rheostat, plug test cord shown in Fig. 4-C into "Trunks & Cords" jack and throw key to "Trunks & Cords" position. Connect the tip test clip of the cord to ground, then touch the ring clip to a lamp contact at some convenient point on the relay rack or the lamp punching on the intermediate distributing frame. Now place a new lamp in this line, press the operate button and note the reading of the milliammeter. Use this reading for a standard for checking the other lamps on the switchboard. A reading of the meter on other lamps of less than that shown on the standard will indicate a high resistance in the circuit, usually in the lamp. Lamps after being in use for an extended period will increase in resistance to such an extent that they may fail to operate the pilot relay under ordinary service conditions.

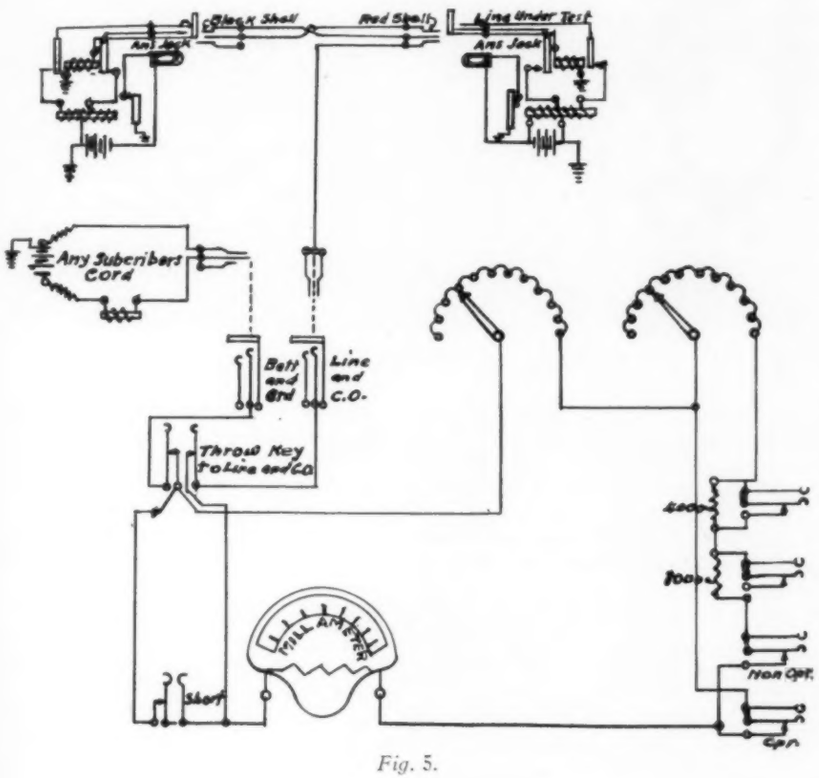


Fig. 5.

The above is only a few of the most common arrangements for using the test set. After one becomes more familiar with it there are many more arrangements under which it can be used to good advantage. Any telephone exchange with one hundred or more relays cannot afford to be without some reliable means of adjusting and testing them. Recently I had occasion to take one of these test sets into an exchange where they were experiencing considerable trouble, even though the equipment appeared to be in good condition. A check of the relays indicated that only 10% would operate on their prescribed current flow and that some would not operate on three times their prescribed operating current. Another important fact was discovered in checking the line relays it was found on some lines that the meter read reverse, which was traced to a reverse tip and ring on the cut off relays. This error was evidently made in the original installation and never discovered.

Hints on Relay Adjustment.

Although the test set will be a great help in keeping relays operating properly, care must be taken in making the adjustments to avoid mechanical injury

to the adjustable parts. In other words relays cannot be adjusted by a "blind man" with a pair of eight-inch pliers. Dirt is one of the greatest enemies of good telephone service, and there is probably no part of the equipment that it causes trouble more quickly than in relay contacts. Dirty contacts cause noise and cut out trouble and may even cause them to stick even though the amount of dirt may be so small that it is very difficult to see. A very good method of cleaning contacts is to hold them apart

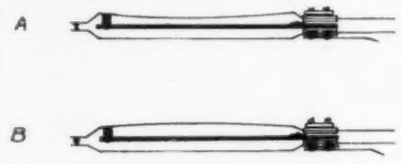


Fig. 6.

and wipe them with a brush slightly saturated with carbon tetrachloride or alcohol. The tetrachloride may also be applied with a tooth pick or can be used to good advantage in an atomizer if one is available. If tetrachloride is used for cleaning in any manner, the contacts must next be burnished to remove the insulating film which usually forms over the contacts in drying and will cause faulty operation. The regular contact burnisher can be purchased at a small cost, or if it cannot be obtained readily a thin knife blade can be inserted between the contacts, while in the made position, and forced back and forth a few times will usually remove the film. A burnisher can be constructed from a piece of spring steel by grinding it crosswise to give it a slight file effect, and if used in the same manner as the knife blade will clean the contacts effectively. Emery paper, sand paper, nail files or the so-called contact files which are intended for use on the large contacts of gas engine spark coils should never be used on telephone relays. In order to keep a permanent adjustment on relays they must always be rigid on their mounting plate. The mounting screws should all be tightened occasionally. Adjust all relays until they have an air gap of about .01 inch (unless the manufacturer specifies otherwise) to allow a positive movement of the armature and insure a positive make and break contact. In adjusting spring type relays a good type of spring bender that fits the spring snugly should be used.

Different sizes of spring benders should be available to fit the different sizes of springs on the relay. A spring cannot always be bent in the exact spot intended with a bender that is much too large for the spring. The first adjustment should be made by bending the spring near the clamping block. If this is not sufficient it may be necessary to bow the spring either in or out. Bowing in the movable springs as shown in Fig. 6-A will decrease the amount of current required to operate it, and bowing out of the movable springs as shown in Fig. 6-B will increase the amount of current required to operate it.

Always bend springs in line of their movement so as not to twist contacts off center. Springs must always have enough tension to close all contacts firmly. On relays having more than one set of springs, the tension should be equally divided if possible between the different sets. Adjust springs on relays such as cut off so that they will make or brake practically together. On break before, make contacts, the outer springs should always follow up slightly when relay operates or releases.

A slight follow up of a spring is always desirable on a break contact of any relay as then a good contact is assured when the armature releases. We have heard a lot about cut and try methods, but in adjusting relays the bend and try is a good plan, or bend just a little and then try on the prescribed current flow, for it is on this plan that the current flow relay test set works well into the scheme of things and proves its worth.

Hoover Specialized Bodies Favored by Utilities

York, Pa.—As a result of close cooperation with the telephone, as well as the light and power fields, a line of special body equipment has been developed by the Hoover Body Company of York, Pa., that facilitates line construction and repair work to a high degree.

The A. T. & T. company and subsidiaries, General Electric, Western Union, New York Telephone, Brooklyn Manhattan Transit and others are employing special bodies developed to meet their particular needs. A specialization in this department of transportation has enabled the Hoover organization to become acquainted with the problems encountered in this field and long experience enables them to assist in solving difficulties that are peculiar to this particular division.

As an illustration of the extent of this work, at the present time more than fourteen different body types have been designed for Brooklyn Manhattan Transit, each one particularly adapted to one phase of the operation.

One of Hoover's Many Telephone Jobs.

International Opens New French Toll Cable

Paris, France—An outstanding event from the standpoint of European international long distance telephony was the recent opening of certain circuits in a toll cable provided by the French government to connect Paris with Strasbourg, capital of Alsace-Lorraine. In the not distant future it will connect also with the Swiss cable system. This cable, which is known as the Paris-Nancy-Strasbourg toll cable, was built in France by Societe Anonyme Lignes Telegraphiques et Telephoniques at its plant in Conflans, near Paris, according to International Standard Electric Corporation specifications and with the supervision of that corporation's engineers. The cost of the project to the French government, when completed, will be about $9,000,000.

The Paris-Nancy-Strasbourg cable is 306 mile in length and includes the latest type of telephone circuits for long distance transmission. Two pairs of small gauge wires are used for a single conversation and each pair carries the voice in one direction only, an arrangement which under certain circumstances is much more economical than the ordinary two wire telephone circuit. Signaling is accomplished by means of currents within the voice frequency range, thus greatly simplifying the signaling equipment. For the greater part of its length the cable contains a total of 376 conductors for telephone and telegraph working. Unlike most similar long distance cables in the United States, it is not suspended from poles but has a protecting steel armour over the lead sheath and is buried directly in the ground.

The Telephone and the Farm

THERE was not a farmer in the world fifty years ago who could talk even to his nearest neighbor by telephone. Not one who could telephone to the doctor in case of sickness or accident. Not one who could telephone for the weather report or call the city for the latest quotations on his crops. Not one who could sell what he raised or buy what he needed by telephone. A neighborly chat over the wire was an impossibility for the farmer's wife or children.

In this country the telephone has transformed the life of the farm.

It has banished the loneliness which in the past so discouraged the rural population and drove many from the large and solitary areas of farms and ranches.

It is a farm hand who stays on the job and is ready to work twenty-four hours every day.

The telephone has become the farmer's watchman in times of emergency.

It outruns the fastest forest or prairie fires and warns of their approach. It has saved rural communities from untold loss of lives and property by giving ample notice of devastating floods. Three million telephones are now in service on the farms, ranches and plantations of the United States.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

BELL SYSTEM

IN ITS SEMI-CENTENNIAL YEAR THE BELL SYSTEM LOOKS FORWARD TO CONTINUED PROGRESS IN TELEPHONE COMMUNICATION

Bell Announces Toll Rate Reduction

Important rate changes on messages to interstate points involving a general readjustment in long-distance rates, and in the evening and night periods, during which reduced rates apply, have been announced by the Bell companies, effective October 1. The net result will be a saving to the telephone users of the country of approximately three million dollars a year. To points 150 miles or more distant the rates are substantially reduced. The greater the distance, the greater the reduction. For example, from Chicago to Detroit, the basic station-to-station rate will be $1.35 instead of $1.60; to St. Louis, $1.45 instead of $1.70; to Pittsburgh, $2.10 instead of $2.70; to New York, $3.40 instead of $4.65; to San Francisco, $8.25 instead of $11.90. Long distance cables, carrier systems, vacuum tube repeaters, loading coils and other improved devices and methods, resulting from continuous scientific research and development applied to the telephone industry, have effected economies on the longer circuits, and have a share in making these reductions possible. A few rates for distances between 24 and 110 miles will be adjusted to make the schedule consistent throughout, but in these cases the increase of the basic station-to-station rate will be only five cents.

One of the interesting changes from the public's viewpoint is that by which one and a half hours have been added to the reduced rate period. Reduced rates on station-to-station calls will begin at 7 p. m. instead of 8:30 p. m., as formerly. Between 7 p. m. and 8:30 p. m. the discount will be approximately 25 per cent of the day station-to-station rates, and from 8:30 p. m. to 4:30 a. m., about 50 per cent of the day rates. These discounts will apply where the day station-to-station rate is 40 cents or more, with a minimum reduced rate of 35 cents.

Because of the unsatisfactory service conditions which it brought about, the existing midnight discount is discontinued.

Under the new schedule station-to-station calls may be made at substantial reductions as early as 7 p. m., and persons wishing to take advantage of the lowest rates of the 24 hours may make their calls any time after 8:30 p. m. Thus, although the midnight discount is discontinued, the longer reduced rate period and the substantial reductions applying in basic rates to distant points mean that this change will make little difference in the cost of night calls.

By this move the company expects to improve service by eliminating complications at midnight which have resulted in delays and put a heavy burden on its facilities and employees.

Another change is the extension of the privilege of reversing charges to include station-to-station calls, whether placed during the day, evening or night, where the rate is 25 cents or more. In the last few years the use of long distance service has been increasing constantly and many situations now arise where the reversal of charges is of advantage to the customer who calls for a certain number.

The keen eye of the "lab" picks perfection *for*— RUNZEL-LENZ CORDS

Every ounce and every inch of the raw material used in Runzel-Lenz cords goes through severe and complete tests in our laboratories. Each length of completed cord is tested before shipment.

The result is that you are sure to get cords that science and the expert specialization of more than a quarter century pronounce the best cords that can be made.

You'll find this thorough care means a big saving for you in your annual cord costs.

Get details of Renzel-Lenz cords before you make your next purchases.

Runzel-Lenz Electric Mfg. Co.

Foremost Makers of Every Kind of Telephone Cord

1751 North Western Avenue CHICAGO

OCTOBER

TELEPHONE ENGINEER

will be distributed before and at the

U. S. INDEPENDENT TELEPHONE ASSOCIATION CONVENTION CHICAGO

October 12-15

Write for rates on advertising in this timely and important issue

The Everhot
No. 50 Blow Torch

In All Weather—

The EVERHOT No. 50 Blow Torch

In driving rain or blinding snow the **Everhot** No. 50 Blow Torch works steadily on, a worthy companion for the hardy linemen who keep communication lines open, regardless of weather.

Protected by its metal windshield, the flame burns steadily under all conditions.

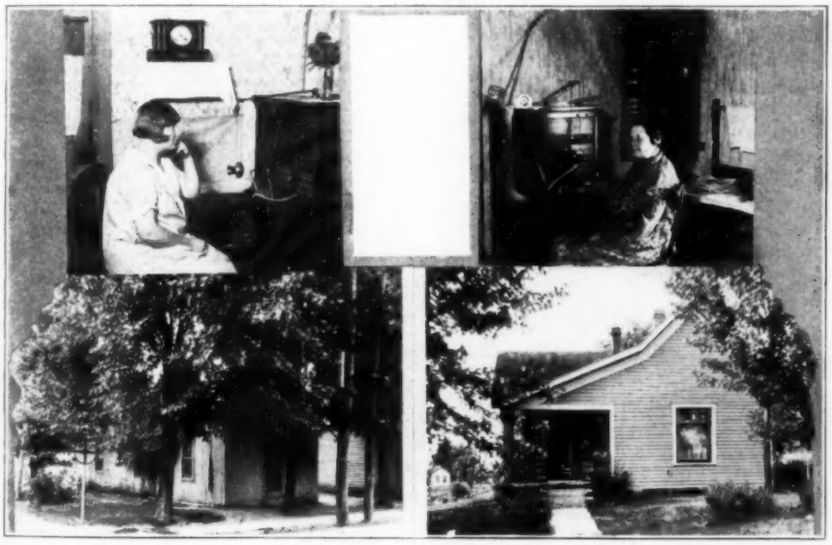
Special features which stamp the **Everhot** No. 50 as a blow torch of sterling quality are:

16 gauge copper tank
Guaranteed long-life burner
Non-enlarging orifice
Reinforced pump stand
(Connection will not strain)
Wind shield

The **Everhot** No. 50 Blow Torch is unrivaled for its ability to generate quickly and for its dependability in those emergencies which tax both men and equipment alike.

EVERHOT
America's Brand Makers
MANUFACTURING CO. MAYWOOD, ILLINOIS

Stromberg in Hoosierland



Here are two of the Stromberg-Carlson installations that bind the Hoosiers together in the bond of pleasing telephone service. At the left is the Stromberg installation at Cortland, Ind., and at the right the exchange of the Freetown Mutual Telephone company at Freetown, Ind. Both exchanges have the Stromberg-Carlson No. 105 Switchboard.

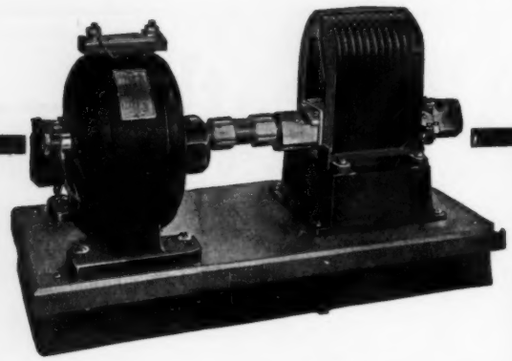
Olathe, Kan.—Damage to the extent of approximately $100,000 was done when lightning destroyed the exchange of the Olathe Telephone company.

Chicago, Ill.—Every bank vault in Chicago is to have a telephone installed if an ordinance recently introduced in the city council is passed.

Santa Monica (Cal.) Starts New Building

Santa Monica, Cal.—Ground has been broken for the new Santa Monica Bay Telephone Company's new six story headquarters building here. The event was attended by local dignitaries and received considerable newspaper publicity. Of the latest indication of the company's growth under the able management of C. F. Mason, the Santa Monica Evening Outlook says:

"Once again the Santa Monica Bay Telephone Co. is proving its confidence in the development of the Bay District, says Manager Mason, declaring that the growth of Ocean Park, Venice and the entire Bay District has made it necessary for his company to install several more units of equipment in the Ocean Park exchange and the present building is not large enough to accommodate this additional equipment. One of the interesting features in connection with the erection of this building is the fact that the telephone exchange, which is now in the old building, will be moved to the new site without interruption to the telephone service throughout Ocean Park, Venice, Del Rey and contiguous territory.



Holtzer-Cabot

MAGNETO—RINGING—MOTOR—GENERATOR

Dependable Service!

This ringing equipment never fails. No attention is required except occasional lubrication.

Once installed your ringing troubles are over and your ringing service is 100%.

Send for illustrated circular. Or better still, give it a test in your exchange. We stand back of the machine.

The Holtzer-Cabot Electric Co.

125 Amory St., Boston, Mass. **6161 So. State St., Chicago, Ill.**

Here is the Place

for your next convention

CAN'T you just picture the wonderful time you would have at world famous French Lick Springs Hotel? Beautifully located in the semi-southern Cumberland foothills of Indiana, French Lick Springs knows no real severity of temperature. The two fine 18-hole golf courses can be played when weather interferes with play elsewhere.

Only 40 miles from the center of population of the United States. The recently completed new wing of the fire-proof, modern French Lick Springs Hotel building includes a well-ventilated ground floor, daylight convention auditorium of 1500 seating capacity, giving this hotel first place among America's convention sites. And, for those who wish, the health-giving waters of the Pluto, Bowles and Proserpine Springs.

Today, get full particulars. Write for illustrated booklet with detailed convention information. Address Convention Secretary, French Lick Springs Hotel Company, French Lick, Indiana.

FRENCH LICK SPRINGS HOTEL

"Home of Pluto Water"

Burch Foraker Made Head of Michigan Bell

Detroit, Mich.—Burch Foraker has been elected president of the Michigan Bell Telephone company. This election came as the culmination of many years of brilliant service in the employ of the New York Telephone company. Mr. Foraker's telephone career started thirty-three years ago, when, while a student at Cornell University, he went to New York to see the sights. He went into the office of the Metropolitan T. & T. company, predecessor of the New York Telephone company, and was offered and accepted a place in the Equipment Department. Later he was transferred to the Engineering Department under J. J. Carty, who was then chief engineer of the company.

During the next two years Mr. Foraker was both a telephone worker by day and a law student at night. At the end of that period he was promoted to the position of foreman in charge of cable and splicing work, and that advancement caused him to abandon his plans for a legal career in favor of one in the telephone business.

The next big jump came in 1907 when he was made superintendent of construction, Long Island, with headquarters in Brooklyn. In the latter part of 1907 he became division plant superintendent, Long Island, and in 1912 was appointed division plant superintendent, Manhattan-Bronx-Westchester.

When the redivision of the territory served by the New York Telephone company was announced by President J. S. McCulloh, creating the Upstate, Downstate and New Jersey Areas to become effective June 1, 1925, it was also announced that Mr. Foraker had been elevated to the position of general manager, Upstate Area. He held that position at the time of his election to the presidency of the Michigan Bell.

CEDAR POLES

NORTHERN + WESTERN

BUTT-TREATING - GUARANTEED GRADES

ANY SPECIFICATIONS REQUIRED

BELL LUMBER CO., Minneapolis, Minn.

"REBUILT" TELEPHONE APPARATUS and exchange equipment saves you 30 to 50 per cent without sacrificing quality or efficiency.

SWITCHBOARDS—Telephones—Apparatus—Protection Equipment—Cable—Everything you need for the installation and operation of a complete exchange—Magneto or Central Energy—of the best and most reputable manufacturers.

Fourteen years' successful operation of our rebuilt equipment department puts it past the experimental stage. Quality and price will make you a permanent customer. Better investigate.

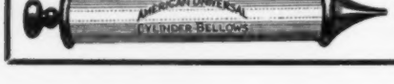
BARGAIN BULLETIN NO. 78 FREE

Address "REBUILT" EQUIPMENT DEPARTMENT

Premier Electric Company 1800-4 Grace St. **Chicago, Ill.**

UNIVERSAL CYLINDER BELLOWS

keep the switchboards and other telephone apparatus free from dust and dirt. One stroke produces a powerful current of compressed air that removes all dust and dirt beyond the reach of a rag. Carried in stock by dealers in telephone supplies, or write direct for literature and prices.



P. PEIFFER

80 LIBERTY STREET

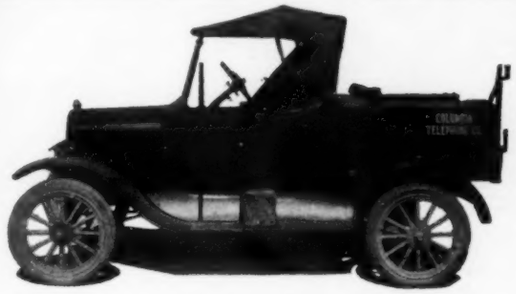
NEWARK, N. J.

POTTER CONDENSERS

Potter Condensers are American made of the highest quality materials. They are built to full capacity. They are very long lived. They are available in replacement sizes and types for all telephone uses.

Potter Condensers are also supplied for A & B socket power devices, power amplifiers, impedance amplifiers, and other radio devices.

POTTER MANUFACTURING COMPANY · North Chicago, Illinois



Type SC-172

Cabinet Body for Ford Roadster

A STRONG, light-weight, convenient cabinet body used in connection with the standard Ford roadster. Soon repays its first cost. Standard equipment with some of the largest telephone and power companies. Equipment includes ladder irons and rear fenders.

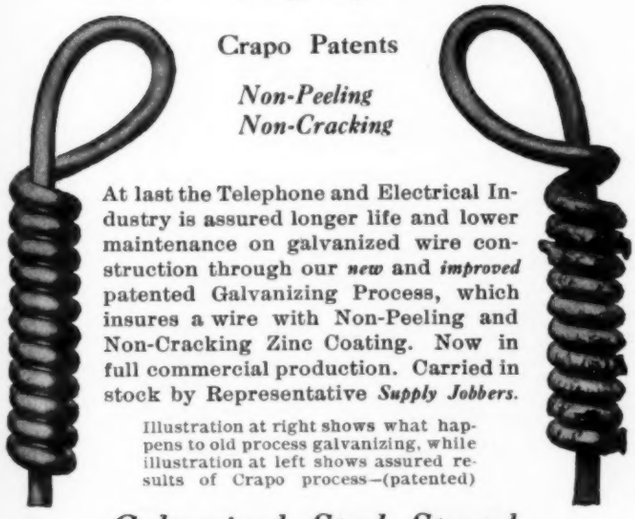
Write for Bulletin No. 214 giving prices and full information

HOOVER BODY CO.

YORK, PENNSYLVANIA

"INDIANA"

Double Galvanized Telephone and Telegraph Wire



Crapo Patents

Non-Peeling
Non-Cracking

At last the Telephone and Electrical Industry is assured longer life and lower maintenance on galvanized wire construction through our *new* and *improved* patented Galvanizing Process, which insures a wire with Non-Peeling and Non-Cracking Zinc Coating. Now in full commercial production. Carried in stock by Representative *Supply Jobbers.*

Illustration at right shows what happens to old process galvanizing, while illustration at left shows assured results of Crapo process—(patented)

Galvanized Steel Strand

Standard or Commercial, Siemens-Martin, High Strength and Extra High Strength Grades

Indiana Steel & Wire Co., Muncie, Ind.

KESTER SOLDER

Rosin Core

In the telephone field Kester Solder is the standard for both maintenance and production work. The comprehensive line of Kester Solder embraces a range of sizes from approximately 1/4″ to 1/16″ in diameter. Standard Acid Core diameter, being 1/8″ and standard Rosin Core diameter 3/32″. Packed on one, five, ten and twenty pound spools, there is a range of size and style of package suitable for every practical purpose.

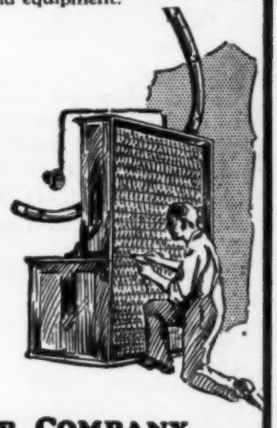
For heavier electrical work Kester Acid Core Solder can be used with considerable saving in time, labor and material.

For the more delicate electrical work on switchboards, etc., only Kester Rosin Core Solder should be used. Its pure rosin flux eliminates every danger of corroded work.

Most telephone companies specify Kester Rosin Core Solder No. 2, 50 core for line splicing as it not only conforms with the standard specifications, but also speeds up this class of work.

Kester Solder either rosin or acid core is handled practically everywhere by jobbers of telephone supplies and equipment.

We maintain a completely equipped research laboratory where we have solved soldering problems for many manufacturers. While our standard line of Kester Solder is adequate for practically every soldering job there are occasions where a specially developed solder and flux are required.



Consult our Research Engineer on your soldering problems

CHICAGO SOLDER COMPANY

4218 Wrightwood Avenue **Chicago, Ill.**

Originators and world's largest manufacturers of Self Fluxing Solder

LINE AND DESK

CORROSION OF BURIED CABLE

A subscriber in eastern Iowa writes us as follows:

"Is there any such thing as electrolysis as to lead sheath of cables through the influence of alternating earth currents?

We know, of course, that this trouble is common when there are direct current earth returns to power house through improper bonding of street railway rails. We seem to be getting a little electrolytic action in our underground cable, which is buried two and one-half feet in the earth without conduit. We have no street railway or direct current generators in this place. We do have a three-phase, three-wire 2200 volt power and lighting system, the neutral wire of which is grounded at each transformer pole, these being placed every three or four blocks. We are not sure whether it is electrolysis or acid in the earth, that is why we would thank you to tell us whether AC currents can cause electrolytic action as well as direct currents. There is also a 13200 volt high line at one end of town."

Men who have studied the question of electrolysis seem, pretty generally, to hold the opinion that alternating currents do not, in themselves, cause electrolysis, although there is some evidence to indicate that there is a possibility that alternating current may accelerate chemical action which is already taking place. It is probable that the trouble mentioned is chemical action. This action takes place quite rapidly in a soil which is rich in organic matter and which contains a considerable amount of limestone. Eastern Iowa soils are likely to be of the type that would cause rather rapid corrosion. An extensive study of this subject was made at Purdue University, Lafayette, Ind., a few years ago and the results were given in a Bulletin of the Engineering Experiment Station of that university, "Self Corrosion of Lead Cable Sheath" by F. O. Anderegg and R. V. Achatz. An abstract of this bulletin was published in TELEPHONE ENGINEER of September, 1924. The only remedy is to prevent actual contact between the cable sheath and the soil.

THRILLS IN CABLE SPLICING

It is seldom we read anything about the cable splicers, but I believe they are as loyal a group of men as can be found in any department.

A short time ago a splicer was working at night in one of our manholes, with a practically inexperienced helper, when suddenly we had a regular cloudburst. Water began pouring into the manhole and filled it up so fast that there was no time for wrapping up the splice in its existing position. So both the splicer and the helper went down into the hole, raised the cable high above the water and wrapped it, while they were standing in water up to their waists. By the way, that is where a splicer gets his greatest thrill—"saving a splice."

As a rule, each splicer aspires to have the reputation of being the best splicer in his district, or division, and of having "lost" the fewest joints. However, all of any considerable experience have lost them at some time or other from difference causes. Some years ago I had a big underground splice leak, after it had been air-tested and found O. K. I naturally felt bad about it, but the foreman told me to forget it, with the remark that the only man that does not lose them is the man that never wipes them.

A splicer always is tremendously interested in the job on which he is working, and feels like that particular part of the business belongs to him until he has finished it and turned it over for service.

Last year we had an estimate in Berkley which had to be completed before the end of the year, in order to give service to a number of line orders which had been promised for completion. We had only a short time in which to do the work. I told the splicers that we had to finish the job in the specified time, in order to give service, and got the answer, "All right, Captain, we will do it."

And they did. This goes to show how much personal interest they take in living up to the company's promise to furnish service at certain dates.

And when it comes to restoring service after a severe storm, fire or whatever it is that has interrupted the service, I have seen the splicers and helpers put out the utmost that there is in them, in order to restore service as quickly as possible. It is easy to see how proud they are when the testboard man says "All O. K." No words of praise are necessary, or could mean more.—A. E. Mathison in "The Transmitter."

WINTER CABLE CONSTRUCTION IS NO SNAP

That it is no snap job to put up several hundred miles of long distance cable, mostly on private right of way, during the kind of winter and spring weather that they have in the state of New York is shown in a recent illustrated article by W. F. Norris in "Long Lines." Eighty-five per cent of the new cable is on private right of way in the back country. This meant that cable reels weighing 3½ tons and loading coil cases weighing a ton had to be transported on dirt roads, over fields, through woods and over rock ridges where there were no roads. At the Ramapo River, a span wire was placed from the main land to an island where a load point was located and the loading pot was trollied over the span wire. Across the Ramapo mountains as many as six reels of cable were drawn through the rings from a single point. Between Schenectady and Utica as much as forty-five hundred feet of cable was pulled through the rings from one point.

To overcome difficulties in traversing rough country, truss caterpillar wheels were introduced on the trailers. This device has a track that is fourteen and a half inches wide and the load is distributed over the six feet of track that is on the ground. The trailer is so flexible that it goes over rocks and stumps without effort and throws mud and snow from its wheels. The ground pressure of the wheels per square inch is only equal to that of a good-sized man walking when the trailer is carrying a three-ton load. The schedule called for the cable to be completed as far as Utica by July 1. Actually the circuits were ready for service to this point on June 26.

EXPERT GIVES SOLDER PASTE INFORMATION

It was with great pleasure that I read the article in your June issue entitled "Soldering, the Biggest Little Thing in Telephony," by Ray Blain.

This article, in my estimation, is well written and bespeaks the best practices to be employed in the construction of any delicate electrical equipment designed to control electrical energy. The only criticism which I have to offer on the admirable article is his reference to soldering paste which possesses bases

The HANDYMAN

POLE PUSHER

NO digging around the leaning pole—no back straining—only one man required. A real saver of time, labor and strength. Straightens leaning poles, takes slack out of wires on corners, moves pole through trench on resetting, holds pole straight while pulling. Light enough for one man to carry and operate. Write for folder and prices.

HARRAH MANUFACTURING CO.
Dept. TE Bloomfield, Ind.

BRACH VACUUM ARRESTERS

at prices within your reach

When the best protection costs no more, why not have it? BRACH arresters insure; non-grounding of lines, cables, clear transmission, balance of potential between pairs, and full protection against power crosses or lightning. There are no carbons to clean and no maintenance bills.

You can readily afford BRACH Vacuum Arresters at our present low prices. Type 440, showr above, is furnished with porcelain base, fuses and mountings.

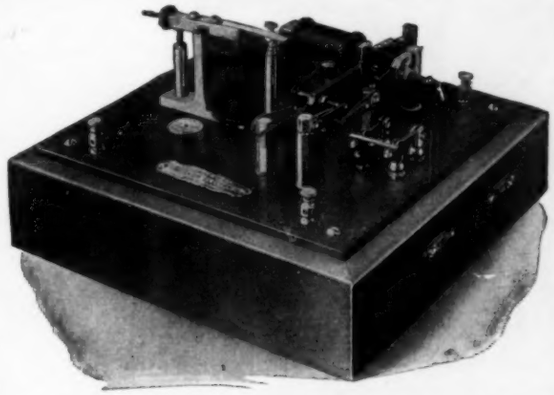
L. S. BRACH MFG. CO.
NEWARK, N. J.

For Maximum Service—Baker Contact Points

DEPENDABILITY and long life are the two essentials in a contact point. This "heart of the machine" should function evenly and steadily over long periods of time—it should not need replacement at frequent intervals.

Baker Contact Points are made with this principle always in mind and the name "Baker" assures that perfect performance, without constant renewal, which is the outstanding characteristic of a *good* contact point. Our contacts are made of Platinum, Iridio-Platinum, Silver and Special Alloys. There are sizes and types for all purposes.

BAKER & CO., INC.
54 Austin St., Newark, N. J.
NEW YORK CHICAGO



WHEN YOU THINK OF THE

WARNER POLE CHANGER

REMEMBER THIS:

Nothing else sums up the advantages of the Warner Pole Changer as strongly as the simple truth that more than 25,000 of these pole changers have been sold to the well operated telephone companies of the country.

Complete details of the Warner will be sent you on request.

WARNER ELECTRIC CO.
MUNCIE, INDIANA

other than acid. It has been my privilege to have tested several hundred fluxes, including many pastes, in the past twelve years, and I have yet to find a commercial paste which does not contain chlorides. Possibly there may be such an item on the market but I have never had the opportunity to come in contact with such an item.

Assuring you of my deepest appreciation for the article by Mr. Blain, and feeling that work done along this line certainly will be of interest to the readers of your paper, I am

Very truly yours,

P. C. RIPLEY,
Research Engineer for Chicago Solder Co.

BUGS WE HAVE SHOT

A case of trouble which I found a few days ago caused quite a little lost time because I took something for granted instead of tracing out the circuit of the station. I went to a telephone on a complaint of "can't be heard" and found that the transmitter did not come up. Looking under the desk I found a set of batteries which did not test up and so I changed them. Still the telephone did not talk up and I spent some time in testing the transmitter and looking over the circuit of the stand and bell box. Finally concluding that the trouble must still be in the battery circuit, I disconnected the batteries and then found that there was still weak battery on the transmitter circuit. After searching around I located the telephone battery in the rear part of one of the desk drawers. The battery which I had changed in the first place was on a buzzer circuit which ran from the desk to a stenographer's desk in another room.—Contributed.

AN EARLY REMEDY FOR CROSS TALK

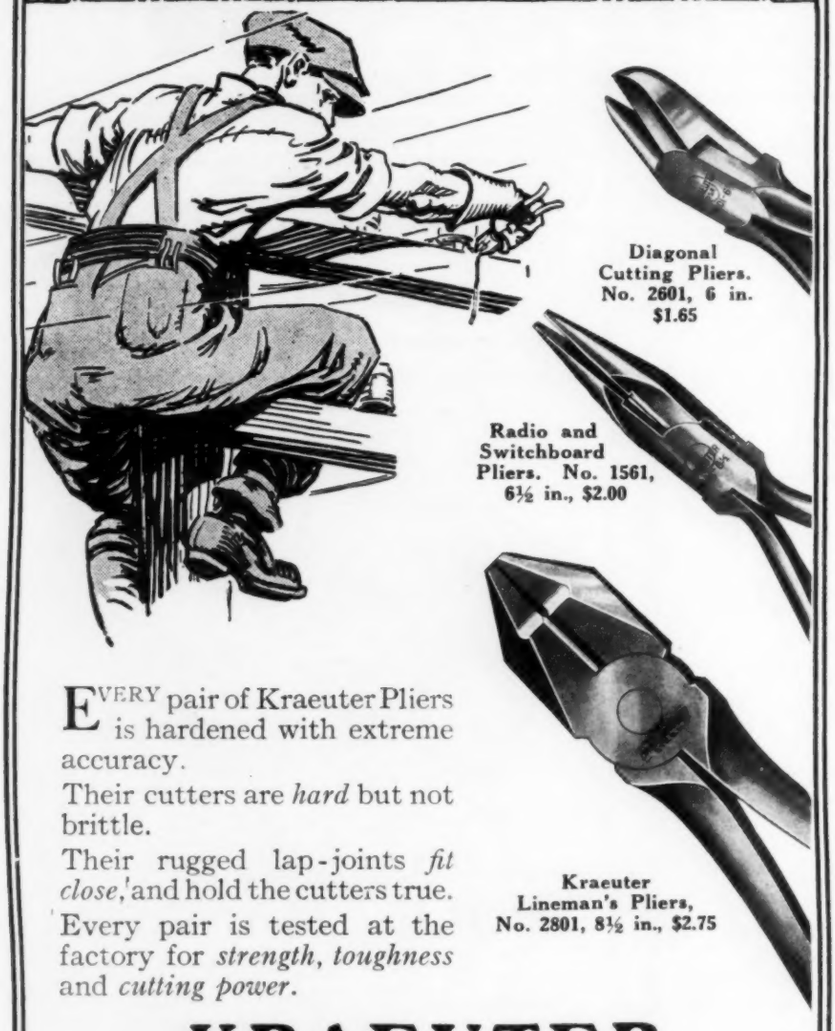
In reminiscing of early days in long distance telephony, Angus S. Hibbard in the *Bell Telephone News*, tells of an early day remedy for cross talk as follows:

"Only grounded wires were used and induction or 'cross talk' from line to line was something terrible. This was especially true of toll lines and, in Wisconsin, we had built some unusually long grounded lines and carried on a pretty dependable service almost as far as two hundred miles. In one experience with this 'cross talk' trouble I recall the toll operator in Milwaukee had been driven from her switchboard in tears because of the abuse of customers who were trying to use lines between which there was very great interference. Taking her place and noticing that two of the customers who were trying to talk to each other were Germans, I asked them if they could talk German, to which both replied 'Yah Wohl.' I then said 'For heaven's sake, go ahead and talk German.' They did this and at once all four customers found that they could go ahead with their business without any trouble. This was the most effective cure for induction I ever found when operating grounded lines."

USE EMERGENCY BRAKE

A Ford car as well as others has an emergency brake lever, yet quite a few Ford drivers overlook this device when most needed simply because they are so accustomed to using their feet and not their head before and during an emergency.—Ray D. Ator in Cincinnati Telephone Bulletin.

KRAEUTER & CO.



Diagonal Cutting Pliers. No. 2601, 6 in. $1.65

Radio and Switchboard Pliers. No. 1561, 6½ in., $2.00

Kraeuter Lineman's Pliers, No. 2801, 8½ in., $2.75

EVERY pair of Kraeuter Pliers is hardened with extreme accuracy.

Their cutters are *hard* but not brittle.

Their rugged lap-joints *fit close*, and hold the cutters true.

Every pair is tested at the factory for *strength, toughness* and *cutting power*.

KRAEUTER PLIERS

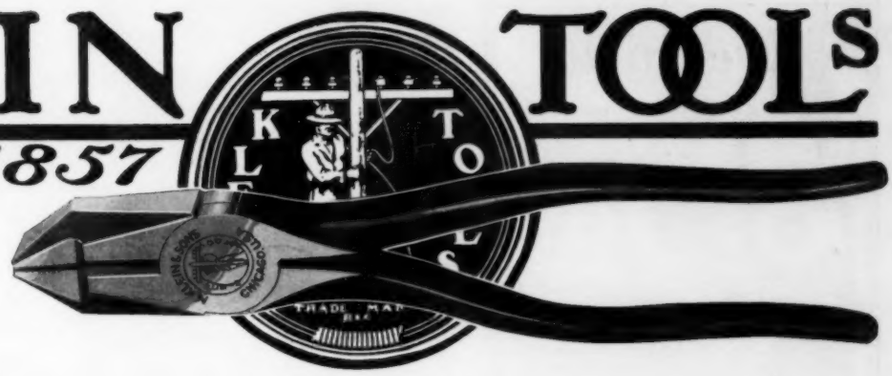
KRAEUTER & CO., Newark, N. J., Established 1860

WRITE FOR COMPLETE LIST OF TELEPHONE BOOKS

—You'll need this list in making your working library most helpful.

TELEPHONE ENGINEER
225 N. Michigan Ave., Chicago

KLEIN TOOLS
Since 1857



Mathias KLEIN & Sons

CROSS ARMS
Fir—Yellow Pine
Plain or Treated
LOCUST PINS, OAK BRACKETS, ETC.
All cross arms manufactured and shipped from Baltimore, Md.
GULF CROSS ARM CO.,
Fairfield, P. O. Baltimore, Md.

J. G. WRAY & CO.
Telephone Engineers
Specialists in Appraisals, Rate Surveys, Financial Investigations, Organization and Operation of Telephone Companies.
J. G. Wray, Fellow A. I. E. E.
Cyrus G. Hill
1217 First National Bank Bldg., Chicago

COFFEY'S
Central Accounting Department
Keeps the records and makes up all reports for companies (large and small) in 17 states. The cost is about half the salary of a bookkeeper. It will not cost you anything to inquire as to our plan, charges, etc. Write today.
CoffeySystem & Audit Co., Indianapolis, In .

SCRAP PLATINUM
Highest prices paid for discarded or obsolete telephone and switchboard apparatus; platinum contact relays, ring keys, etc. Have specialized in this field for many years.
CONTACT METALS CO.
221 E. 23rd St., Chicago

Send for free sample and prices on
UNIVERSAL DROP WIRE INSULATORS
Universal Specialty Company
128-A, S. 7th St., Terre Haute, Ind.

TELEPHONE EQUIPMENT

Western Electric 1020-AL common battery desk sets with steel bell boxes	$10.00
W. E. No. 46 and No. 20 induction coils	.50
W. E. 1-MF condensers...	.35
W. E. 2-MF condensers..	.50
W. E. No. 110 and No. 47 switchboard plugs, 35c and 25c	

BUCKEYE TELEPHONE & SUPPLY CO.
COLUMBUS, OHIO

Get your
Telephone Repair Work
done at the old reliable
Telephone Repair Shop
SUTTLE EQUIPMENT CO.
LAWRENCEVILLE, ILL.

London, Eng.—A new booklet descriptive of the Macadie automatic coil winder and the Avometer, an instrument for giving accurate readings (direct current) of amperes, volts and ohms, has been issued by the Automatic Coil Winder and Electrical Equipment Co., Ltd., Wellington House, Buckingham Gate, London, S. W. 1.

Cando, N. D.—C. G. Hilliard of Langdon has bought the Cando telephone company.

CEDAR POLES
Quick Delivery
Prices and Quality Satisfactory
"Producer Direct to Consumer"
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Seguin Bldg., 421 St. Paul St.
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Specialization on Public Utility Accounting Records and Audits enables us to best serve Telephone Companies.
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During recent years I have been privileged to appraise Telephone Exchanges all over the United States. The list totals 520. Would you like to avail yourself of my services?
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6" 2-way	2,200 lbs.
6" 4-way	6,000 lbs.
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10" 4-way	16,000 lbs.

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No.17 B & S Gauge CopperClad Twisted Pair outside telephone wire.

One conductor of the pair regularly spaced raised section in the weather-proof compound, which acts as a marker.

Less than 25,000 ft.	$9.00 M ft.
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The above offered subject to prior sale. Wire or write immediately.

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J. T. Moran Heads Bell Pioneers' Society

New York City.—James T. Moran of New Haven, president of the Southern New England Telephone company, was elected president of the Telephone Pioneers of America at the annual convention of the organization at the Hotel Commodore. Mr. Moran succeeded H. B. Thayer, chairman of the American T. & T. company as head of the pioneers organization.

Other new officers are: Senior vice president, F. A. Stevenson, director, Long Lines Department, American T. & T. Co.; vice presidents, Roderick Reid of Denver, vice president, Mountain States T. & T. company; J. P. Hansen of Chicago, instructor, Illinois Bell Telephone company, and P. O. Coffin of Washington, vice president of the Chesapeake & Potomac Telephone company. R. H. Starrett, assistant to vice president, American T. & T. company, was reelected secretary, and W. J. Stout, assistant treasurer of the American T. & T. company, was reelected treasurer of the pioneer organization.

The new executive committee consists of: E. K. Hall, vice president of the American T. & T. company; J. L. Kilpatrick, vice president, Western Electric company; B. A. Kaiser, special representative of the American T. & T. company; Leslie Killam, general plant superintendent of the Wisconsin Telephone company, and Miss Katherine M. Schmitt, supervisor of Training Schools for Operators, of the New York Telephone company.

Following the executive session visits were made by 2,000 pioneers who attended the convention to the Bell System Laboratories, the long distance central offices at 24 Walker street, and the Walker Machine Stitching central office, one of the largest of its type in the world, also at 24 Walker street.

An address was given during the concluding session of the convention by Thomas A. Watson, who made the first telephone instrument and heard the first message sent by telephone. A demonstration of the new talking moving pictures also was presented.

Quaker Meet Is Held at Sesquicentennial

Philadelphia, Pa.—A combination of the usual active meeting of the Pennsylvania State Telephone and Traffic Association and the attractions of the Sesquicentennial Exposition proved to be a magnet for a big attendance at the 1926 annual convention of the Pennsylvania telephone men.

Per schedule, the Pennsylvania program was packed with practical pointers and a lot of definite evidence of the association's value to its members was put forth in the annual report of President Bradley. The Pennsylvania chief was completing his 25th year in association work, being the sole survivor of the sturdy pioneers who formed the Eastern Traffic Association.

After J. F. Stockwell, executive vice-president of the Keystone, had opened the session with a glowing welcome to the visitors, H. E. Bradley presented his survey of the past year from the president's point of view. Routine work comprised the greater part of the schedule for the last year and that labor increased considerably. The toll clearing house of the association handled 114,553 more messages in 1925 than it did in 1926. Transfers of ownership of Pennsylvania properties were made with enough frequency last year to prove a factor in the association's work. President Bradley called for more prompt notification of the association when transfers were being contemplated, so arrangements might be made at headquarters for handling business under the new alignments.

W. S. Paca of Oil City spoke on the first fifty years of the telephone and stirred up some lively reminiscences with his vivid address which made use of historic material he had gathered as well as drawing on his sharp memory of a splendid career. W. J. H. McIntrye, telephone engineer for the Pennsylvania commission, counseled greater co-operation among telephone companies in solving the problems that were presented to the commission.

Charley Deering, secretary of the national association, lit into the unsound financing methods that are having their crowded hour of glory in the telephone industry. He presented his warning in specific and convincing fashion and after pointing out this peril spoke on the vital necessity of preserving and extending a strong Independent branch of the industry.

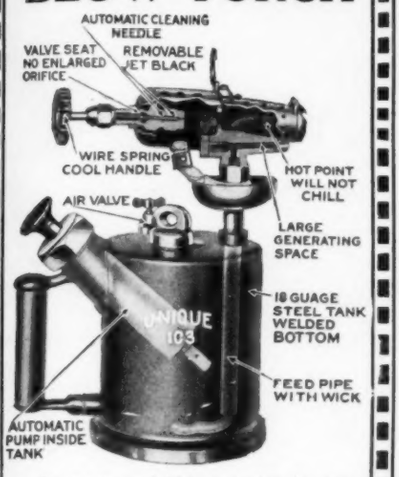
What the Independents have done in speeding the growth of Canadian telephone companies was related by Francis Dagger, supervisor of telephone systems, Providence of Ontario. Mr. Dagger paid tribute to the aid of the U. S. I. T. A. in getting the Independent telephone industry in Canada on a sound basis with respect to its relations with the government, the public and competitors. He told of the movement now in progress to consolidate the smaller companies, and gave details of the Ontario Telephone Act which incorporated many details he drafted.

Commercial men had their inning when I. D. Gindhart, Jr., superintendent of the Keystone's new business department, spoke on "The Commercial Man's Job." He advised "beating criticism to the draw," and told how his department handled this end of the work. Mr. Ginhart gave in detail many of the methods that have proved successful in the Keystone's work and which may be adapted by smaller companies. Another highly instructive address came from J. C. Boush of L. M. Berry & Co., Dayton. In telling how to make the directory pay, Mr. Boush drew on the extensive experience of the Berry organization which is the ranking company in this line of work.

The entertainment for the convention, in addition to the impromptu affairs arranged by the sprightly exhibitors, featured a luncheon at which W. Freeland Kendrick, mayor of Philadelphia, spoke, a ride on the mayor's private yacht, and a golf tournament. George Rodormer was an easy winner of the golf tournament, which was not altogether unexpected considering his prominence in pasture pastime circles.

Midland, Texas.—C. L. Alderman of Dallas has bought the Midland and Odessa telephone systems. Improvements are planned.

UNIQUE BLOW TORCH



It starts quickly, operates in any position, and produces a remarkable heat. It is a great worker in cold and windy weather.

The automatic orifice cleaner, one of the details shown in the illustration, is but one of a number of exclusive features that make the Unique your greatest value in blow torches.

Painstaking care by interested workmen, an actual "burning test" before shipping, is just another detail responsible for their uniformity and efficient burning qualities.

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Unique Manufacturing Co.
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RECONSTRUCTED EQUIPMENT

Dean Common Battery Straight line steel hotel sets @	$ 5.00
Dean Common Battery Steel hotel sets with 16-33-50 or 66 cycle ringers @	5.50
Kellogg No. 2696 type 3-bar 1000 ohm Bdg. compacts @ $8.00—4-bar 1000 or 1600 ohm $9.00—5-bar @	9.75
Stromberg No. 599 type 4-bar 1600 ohm Bdg. compacts @	6.90
Kellogg No. 39 Common battery desk sets with No. 75 straight line steel bell box @	6.75
Kellogg No. 97 Common battery desk sets with No. 75 Straight line steel bell box @ $8.00—Harmonic with 16-33-50 or 66 cycle ringer @	8.50
Stromberg 1000 ohm self contained ringers with gongs @	1.35
Kellogg, Stromberg or Western Elec. 1600 ohm self contained ringers with gongs @	1.50
Kellogg No. 28 type 3-bar 1000 or 1600 ohm Bdg. desk set @ $10.00—4-bar $11.00—5-bar @	12.00
Western Elec. No. 20 desk stand with Kellogg Trans. and Rec. and 3-bar 1000 or 1600 signal set @ $10.00—4-bar @ $11.00—5-bar @	12.00
Stromberg No. 428 3-bar 1000 or 1600 ohm Bdg. desk set @ $8.75—4-bar $9.25—5-bar @	9.80
Kellogg No. 26 Receivers with cords @	1.25
Kellogg Local or Common battery transmitters complete with mouthpiece and backs @	1.10

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E. C. Stoeffhaus, Mgr.
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We are not connected with or successors to Rebuilt Telephone Equipment Co.

Middle States Busy in Rebuilding

Leon, Iowa.—The Middle States Utilities company of Iowa has begun reconstruction work on its plants at Leon, Davis City and Lamoni, Ia., and at Blythedale, Mo. A new toll line will be built from Leon to Lamoni by way of Davis City. The material for this is on hand. Work will start at once. At Lamoni, Ia., Middle States has laid 1,600 feet of underground cable and rebuilt some lines in town.

Material is on hand (including 9 carloads of poles) to completely rebuild the rural lines. Work on this will be pushed to completion before cold weather. The company also hopes to lay several hundred feet of cable this fall. At Blythedale, Mo., work is in progress rebuilding the plant completely with some aerial cable and all new lines in town and country. The company expects to greatly improve its service by rebuilding these plants.

R. R. Wilcox is division manager of these exchanges, with headquarters at Leon, Iowa.

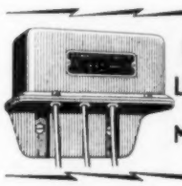
Publicity Fights West Coast Phone Spongers

Redondo, Cal.—Picking the "sponger" of telephone service as one of the prime community nuisances, E. C. Dearth, manager of the local telephone company, has indicted that pest so forcibly as to make the subject one of considerable newspaper interest. The *Redondo Daily Breeze* recently devoted a column to Dearth's denunciation of the service grafter as a penalty to the community's businessmen and householders.

Round Table Talks Feature the Northern Hoosiers' Meet

Lake Manitou, Ind.—With Vice President Frank V. Newman of La Porte presiding the Northern Indiana Telephone association conducted a two day round table session here during which problems of operation, management and construction were discussed. Toll charge methods, reports of material and labor used in construction and maintenance and an operators' conference were high spots of the meeting. Among the well known speakers at the meeting were Henry A. Barnhart, Judge N. G. Hunter, Max Hosea, D. H. Whitham, Frank E. Bohn, H. E. Gray and Miss Marguerite Norris.

A lively entertainment program was staged for the visitors.



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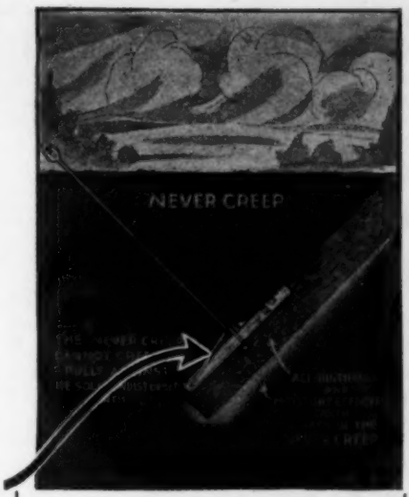

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In sandy, moist, adobe, or any other soils, the great holding surface of the NEVER-CREEP and its pull against solid, undisturbed earth gives an anchorage that is unsurpassed.

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Foremost wire companies prefer the NEVER-CREEP. So will you when you learn its complete story. Write us for details.

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N. SLATER CO., INC.
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"ALWAYS RELIABLE" TORCHES AND FURNACES

Made in all sizes and grades. Write for catalog illustrating and describing entire line.

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Stocks in Newark, N. J., New York City, Chicago and San Francisco.
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The "STEWART" Cable Tester

Locates shorts, crosses, grounds and wet spots to an inch. Will often save its cost on one case of cable trouble.

Order a "STEWART" Cable Tester and be sure you are going to locate your next case of cable trouble quickly.

Any telephone man can use it. Not an instrument that only an expert can use.

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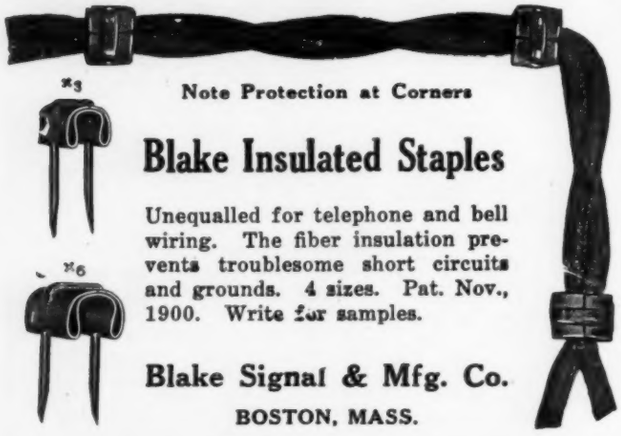

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For prices and particulars of Meredith's Single and Multiple Conduit

Determining factors for installing a Unit Position Sectional Type Switchboard

This unit position sectional type switchboard is designed to handle efficiently the traffic on exchanges having from 300 to 1200 local lines and in addition the toll and rural lines of the exchange.

The line equipment may be of the convertible type, which may be installed for magneto lines and converted to common battery individually whenever desired.

Each position section is packed and shipped as a complete unit; all cord equipments are installed, adjusted and tested ready for operation in our factory.

The circuits are arranged in the simplest manner. Transmission losses are extremely low and the operation of the circuits and equipment leaves nothing to be desired from an operating and maintenance standpoint.

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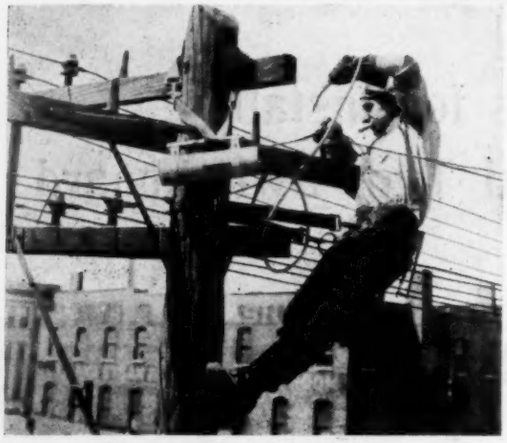

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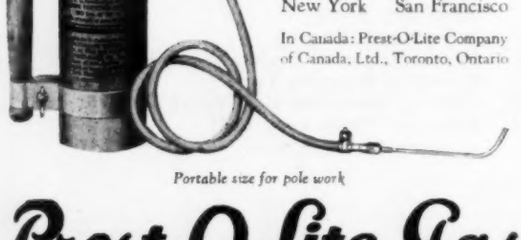

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